

Why Have A Circulatory System?



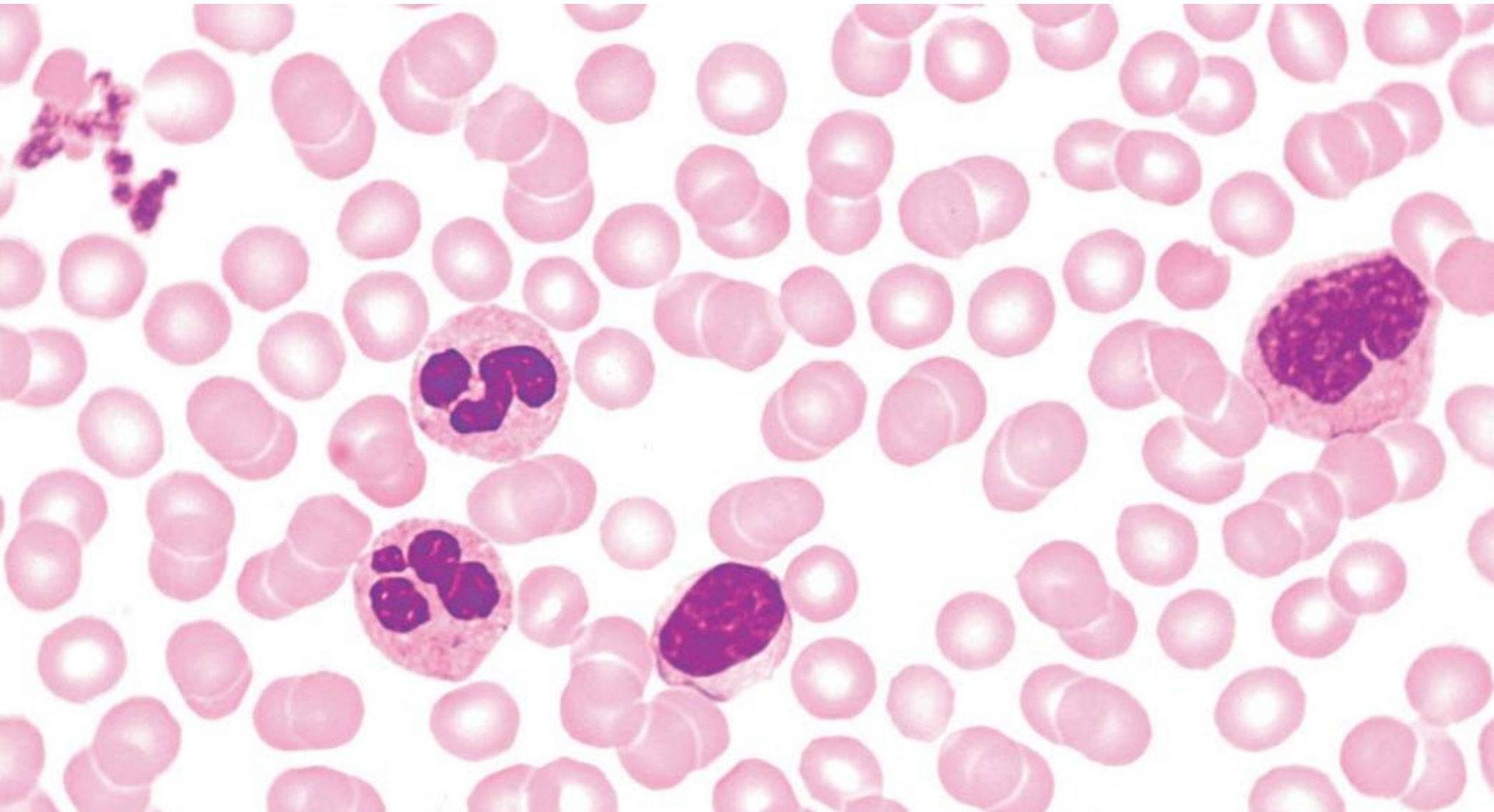
Pump

Pipes

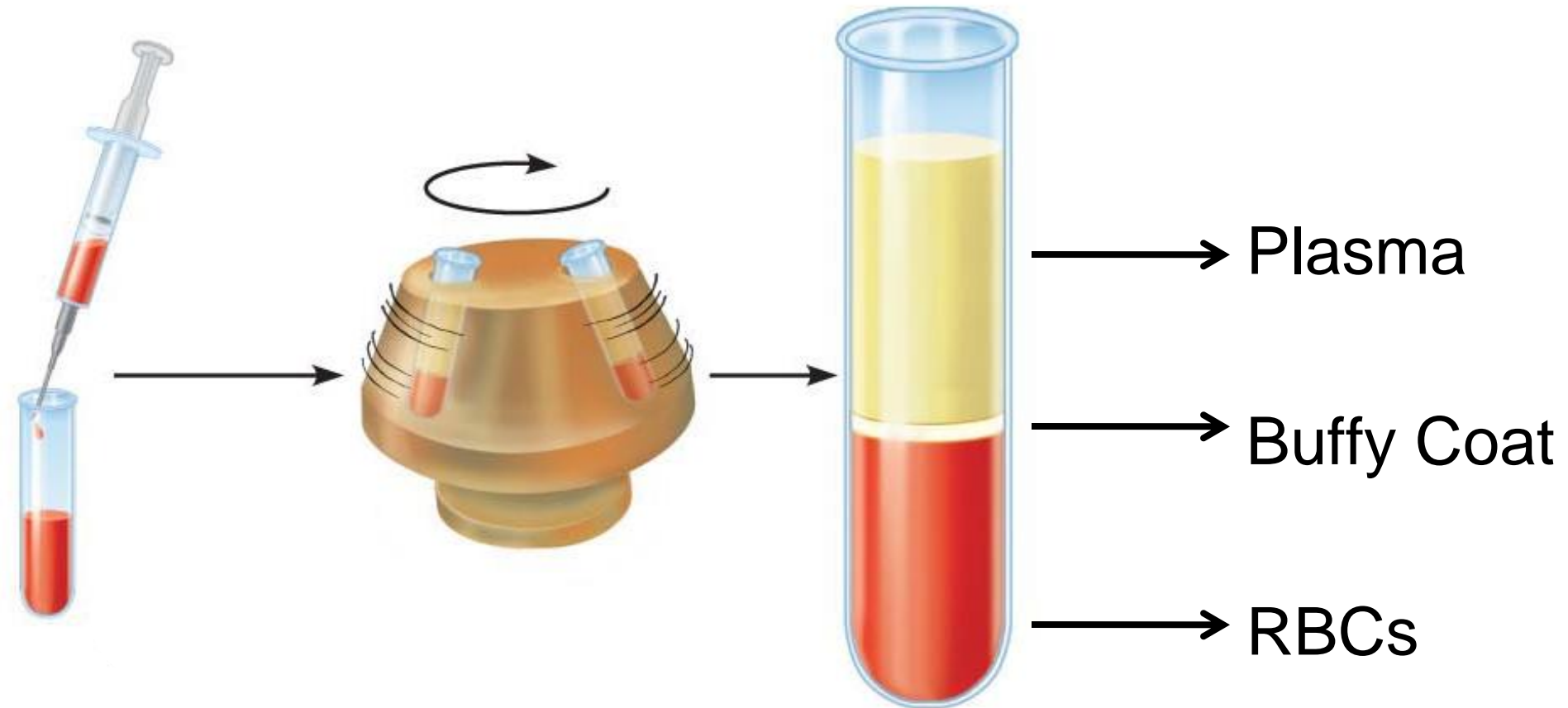
Liquid

Blood = Fluid connective tissue

- Formed elements in plasma.



3 Components of Centrifuged Blood



Blood – Physical Characteristics

- Color



- Viscosity



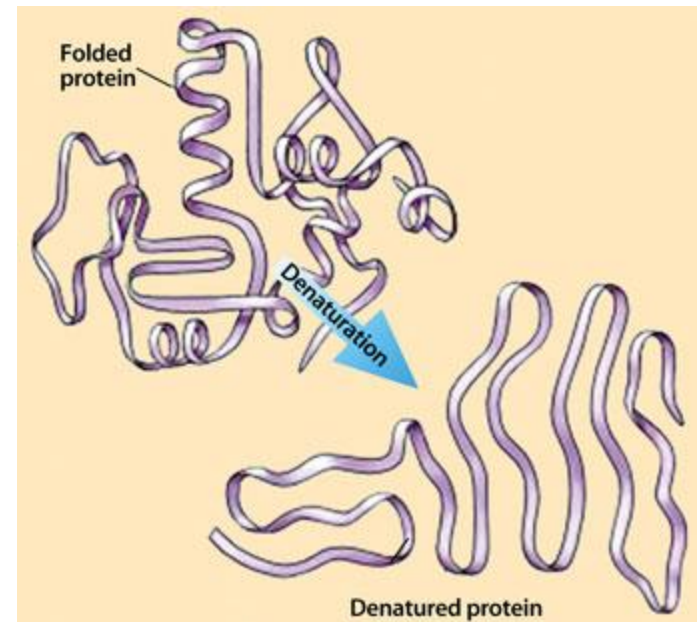
- Volume



- Temperature

Blood pH

- $\text{pH} = \log (1/[\text{H}^+])$
- 7 is...
- >7 is...
- <7 is...
- Why does pH *matter*?



Blood - Functions

- *Distribution*
- *Regulation*
- *Protection*

Plasma

- 48-58% ♂

- 53-63% ♀

- 90%

- *What's dissolved?*



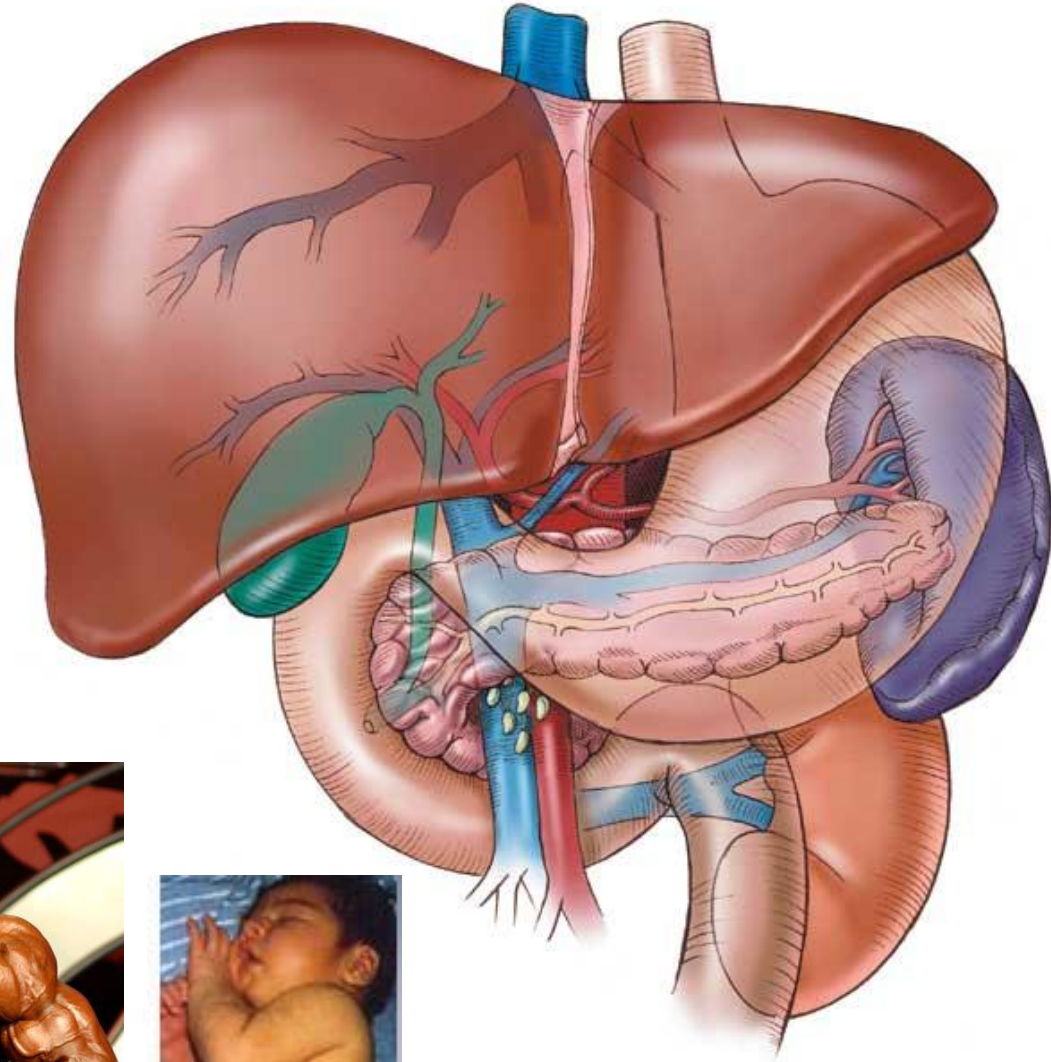
Plasma Proteins: Albumin

- Most abundant.

- Maintains



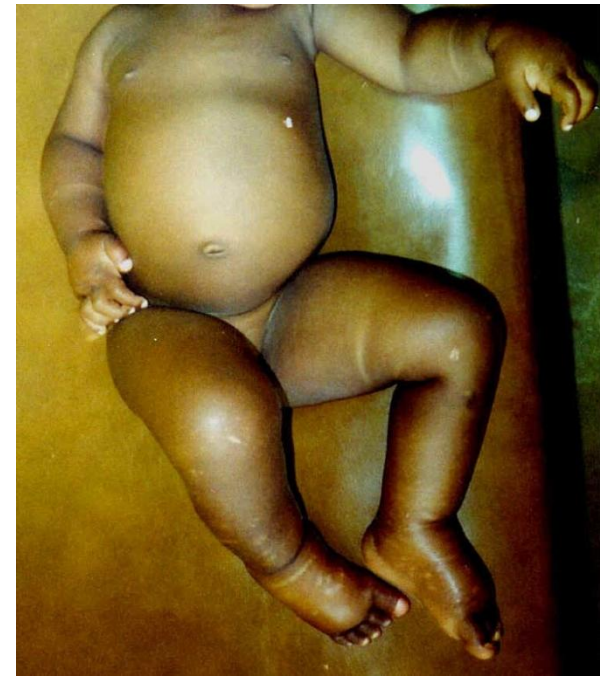
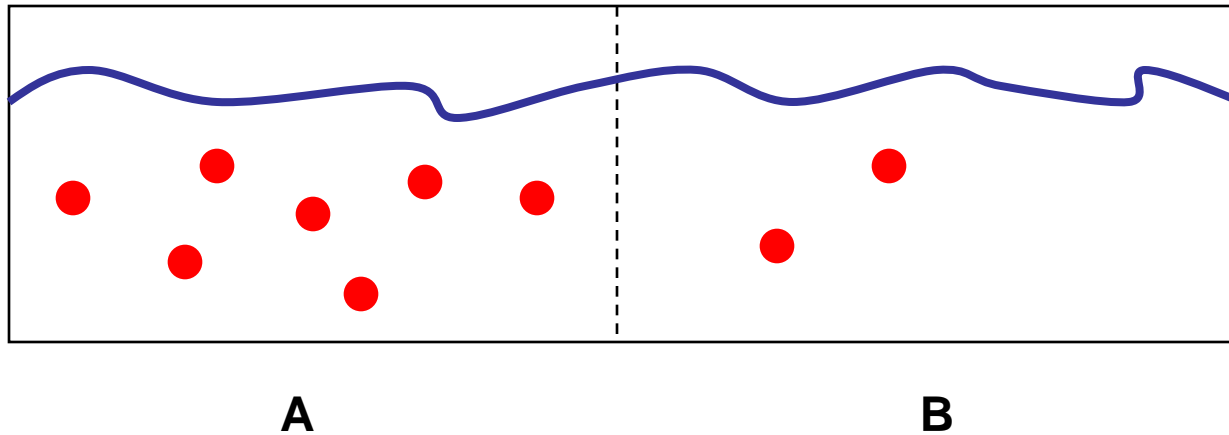
- Transport



Osmotic Pressure

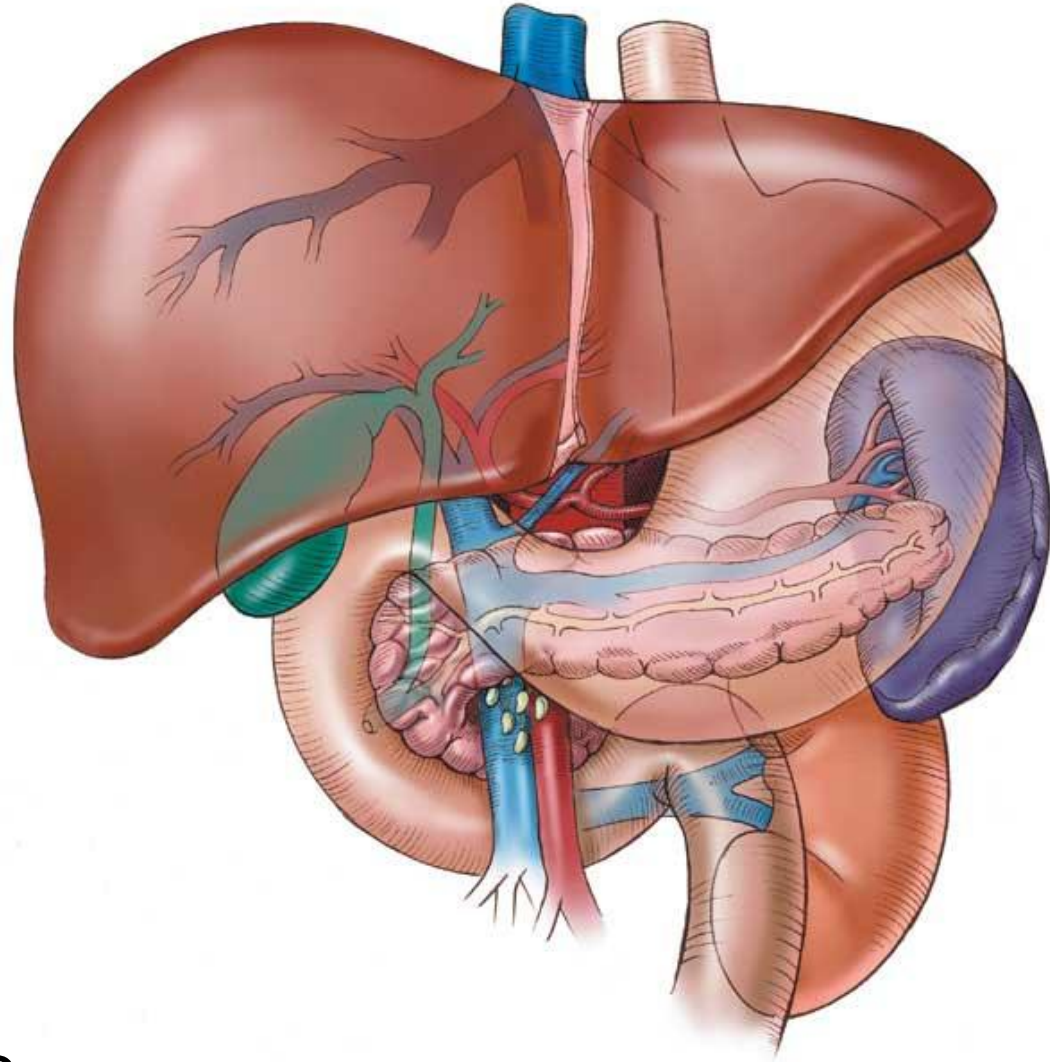
2 solutions separated by a semi-permeable barrier. Water can pass through the barrier, but red particles cannot.

- *Which direction will water flow?*
- *Which side (A or B) has the higher osmotic pressure?*



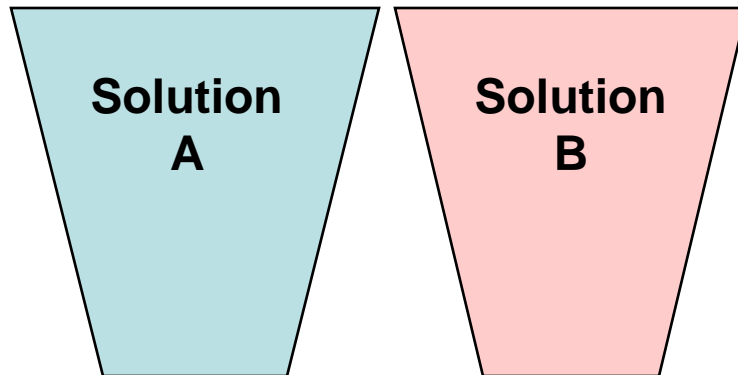
Plasma Proteins: Globulins

- Transport
 - Metal ions
 - Lipids
 - Fat-soluble vitamins.
- Antibodies
 - Made by plasma cells during the immune response.



Buffers

- Resist changes in...
- *Why are they necessary?*
- Albumin
- Bicarbonate (HCO_3^-)



10mL of HCl were added to A and its pH dropped by 4 units.

10mL of HCl were added to B and its pH dropped by 1 unit.

Which solution is the better buffer?

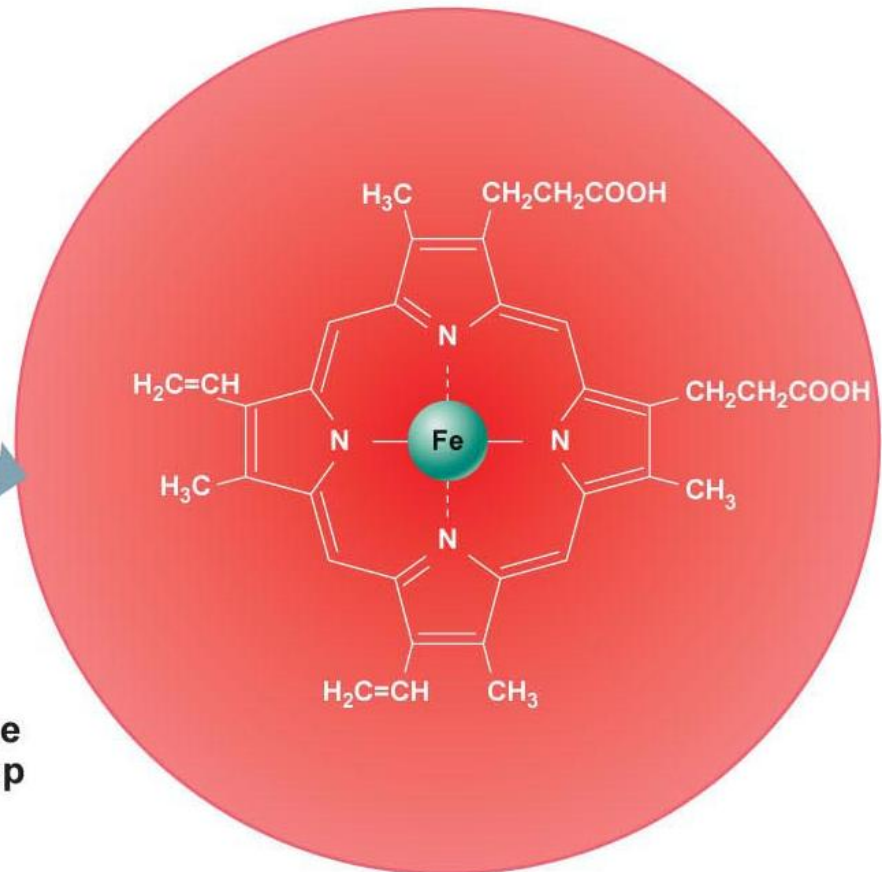
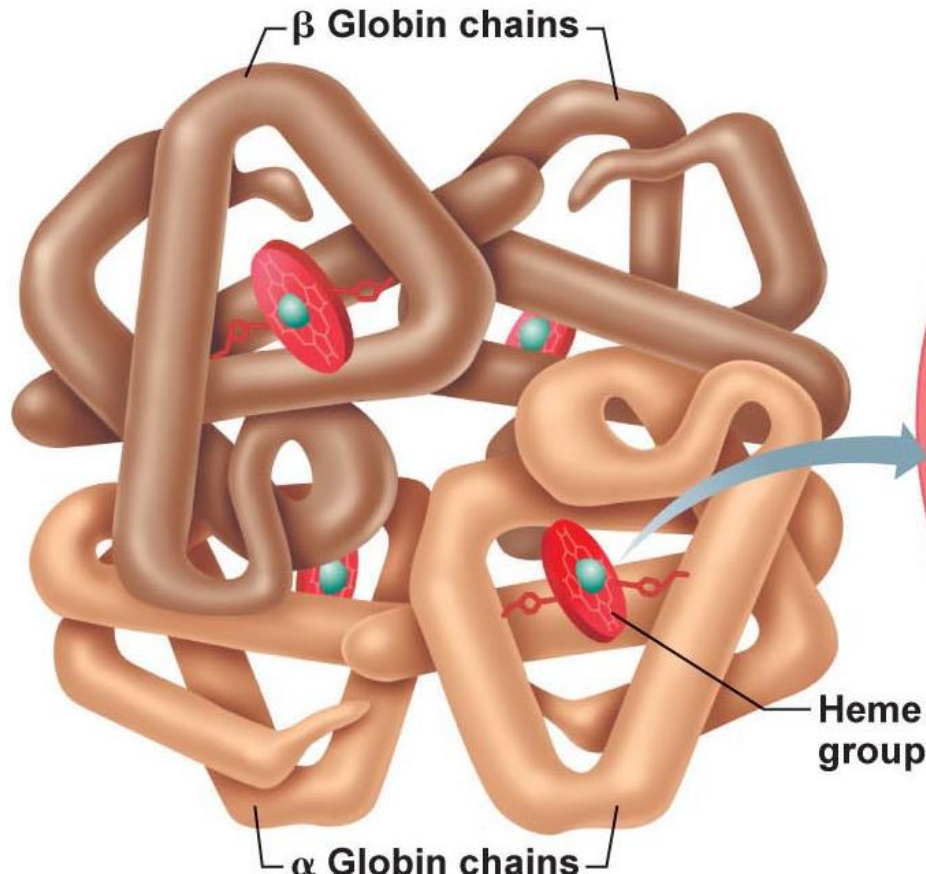
Erythrocytes

- Small (7.5 μ m).
- 4-6 million per μ L of blood.
- No nucleus and no organelles
- Biconcave disks.
- Stuffed with...
- Transport...



Hemoglobin

- 2 alpha chains/2 beta chains
- 4 heme groups
- 4 irons
- Oxyhemoglobin
- Reduced hemoglobin
- Carbaminohemoglobin

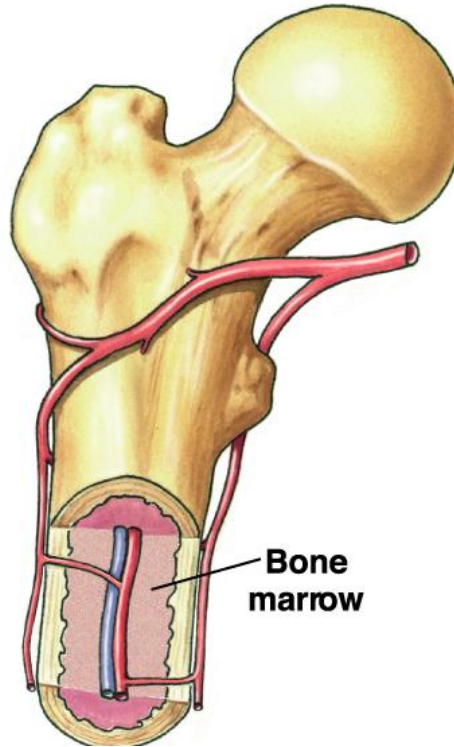


Hemopoiesis

- Blood cell production

- *Where?*

- Hemocytoblasts.



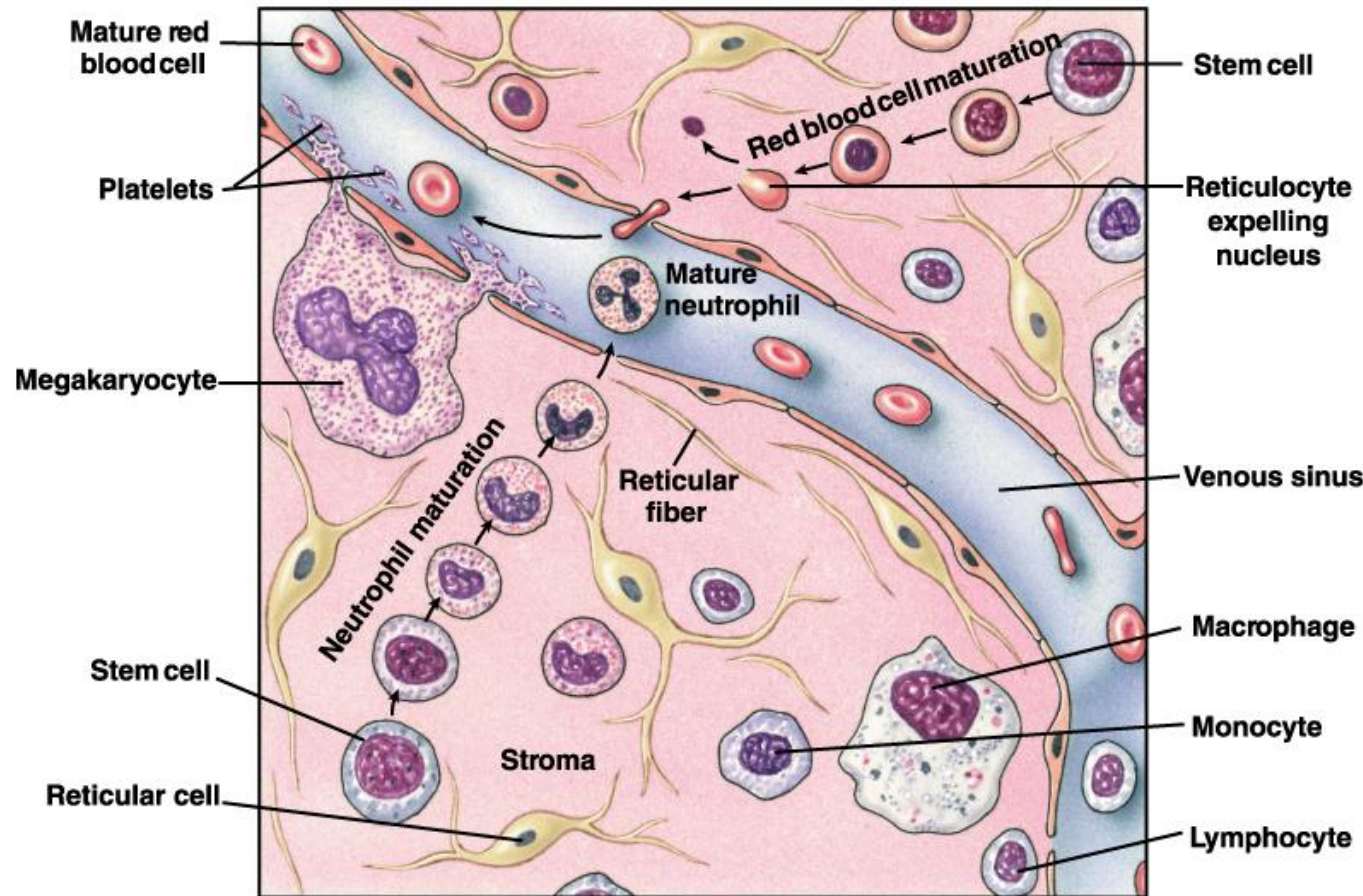
Erythropoiesis

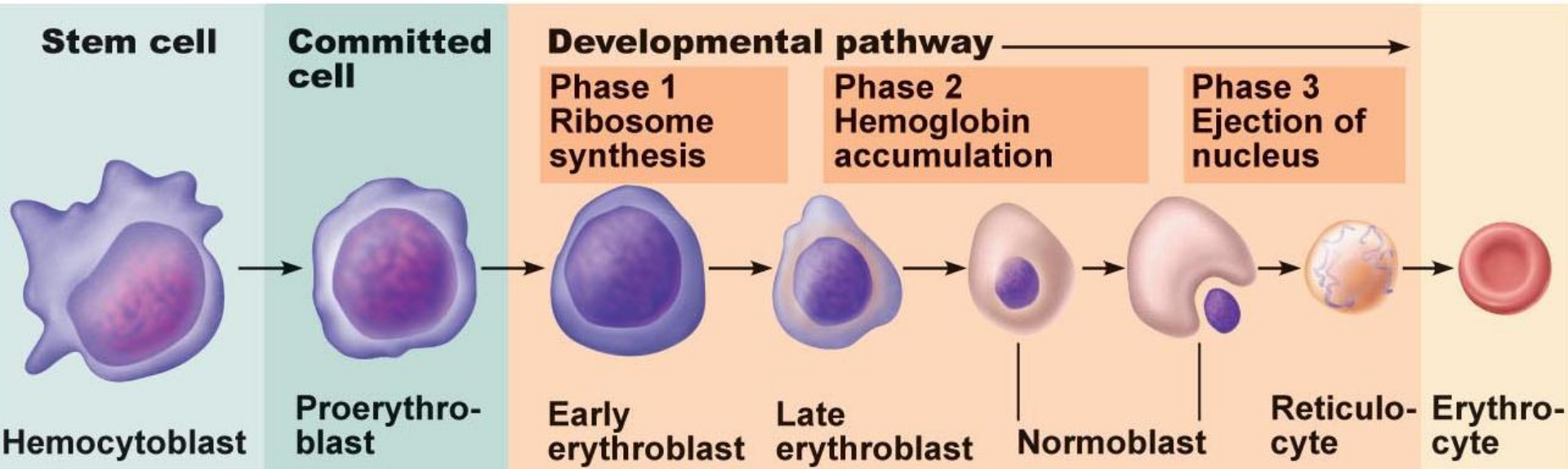
- *Where does it occur?*

- *Stem cell?*

- *Metal?*

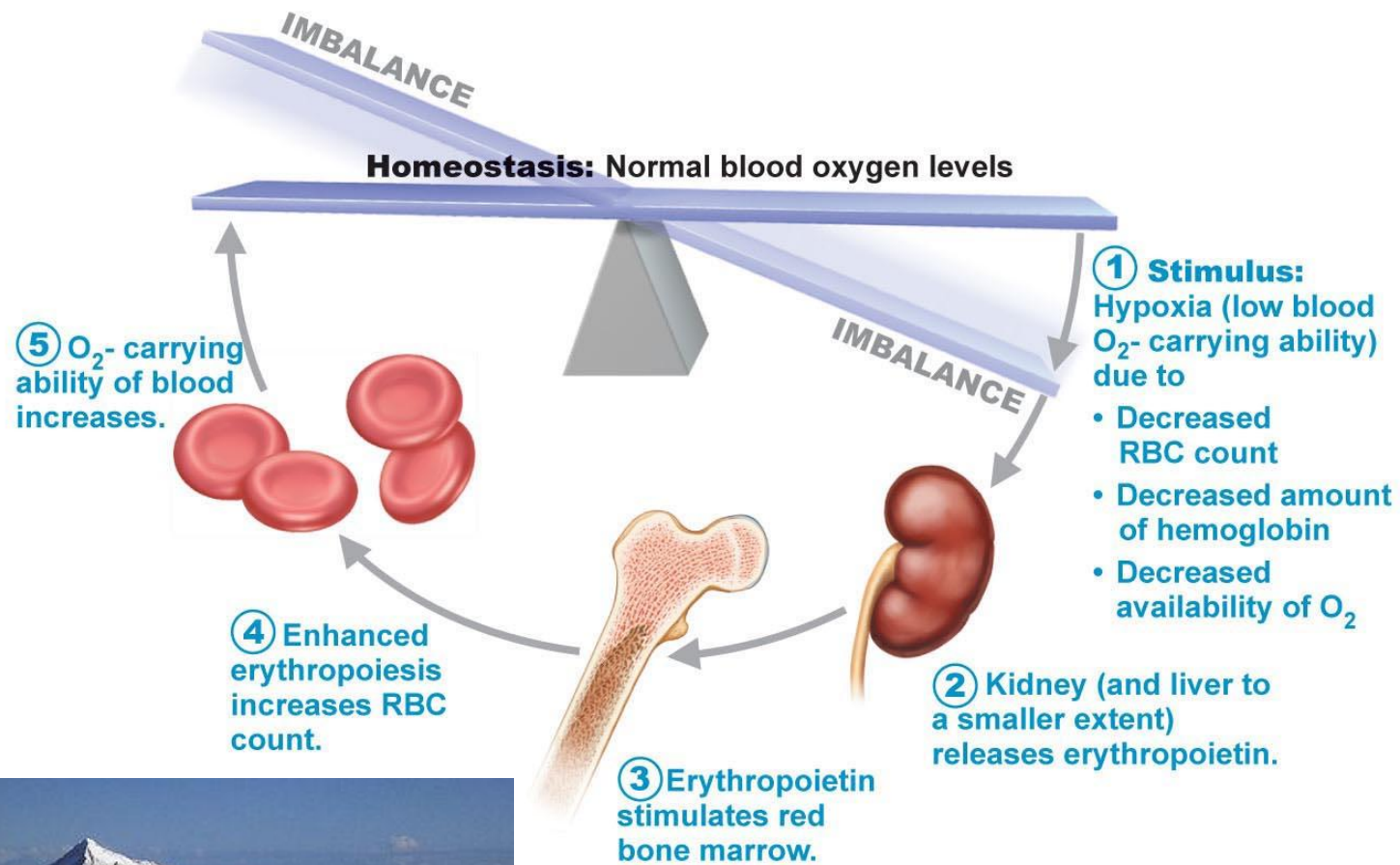
- Erythropoietin





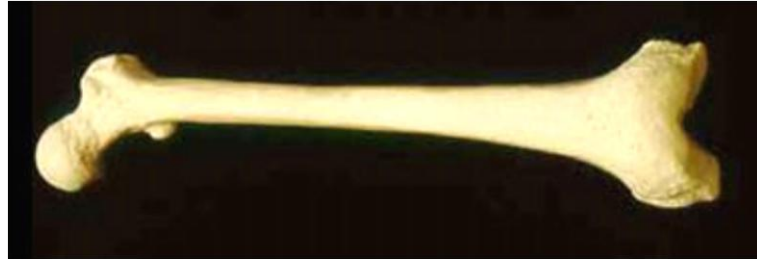
As a hemocytoblast differentiates into an RBC:

- What must be lost?***
- What must be made?***
- What shape change occurs?***



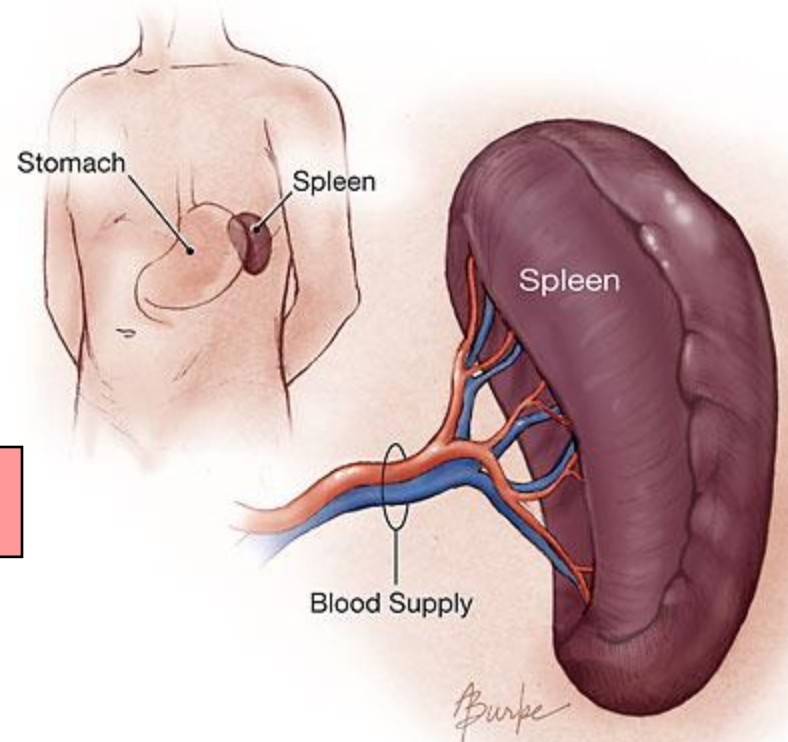
Erythrocyte Life Cycle

Born in the...

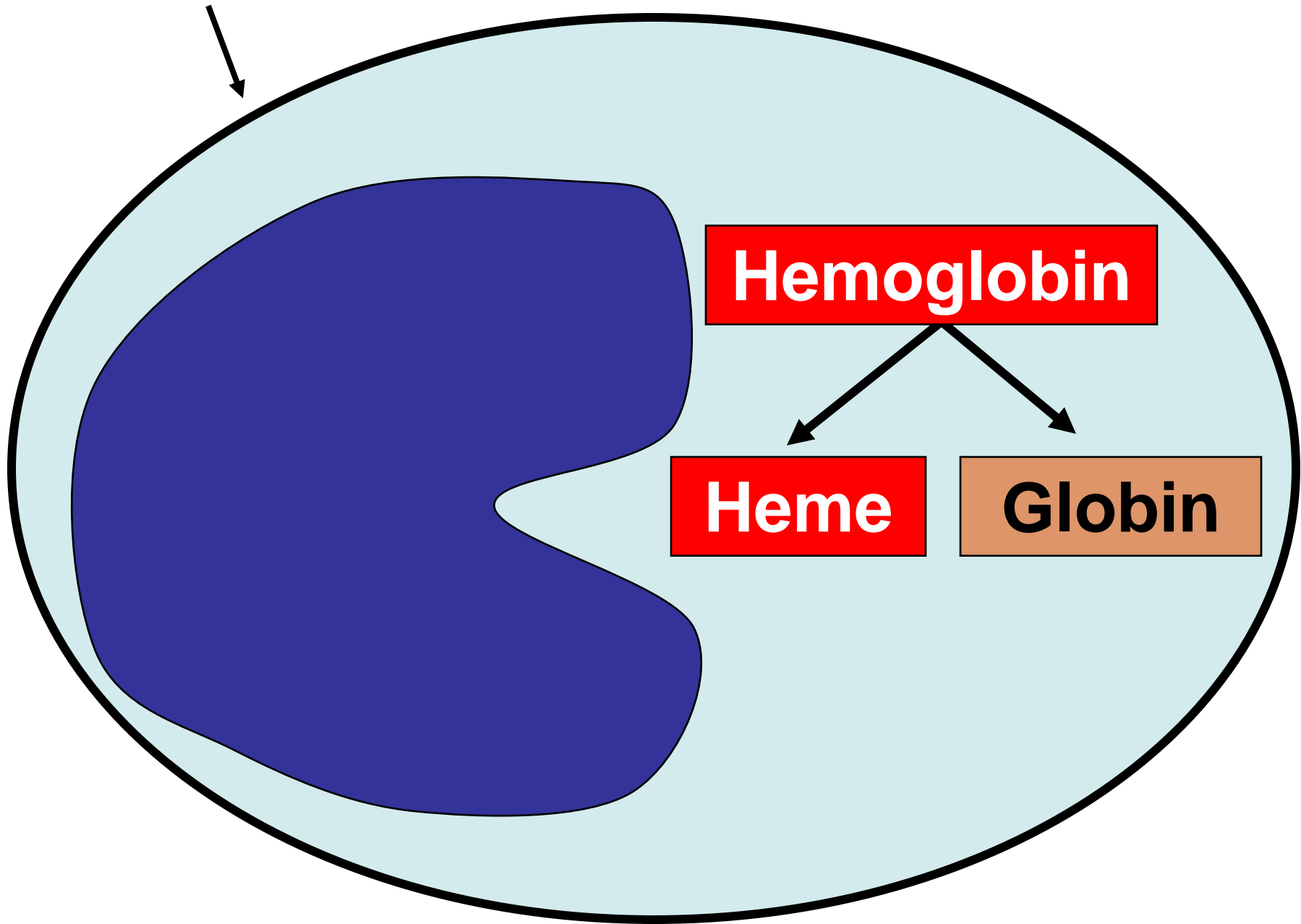


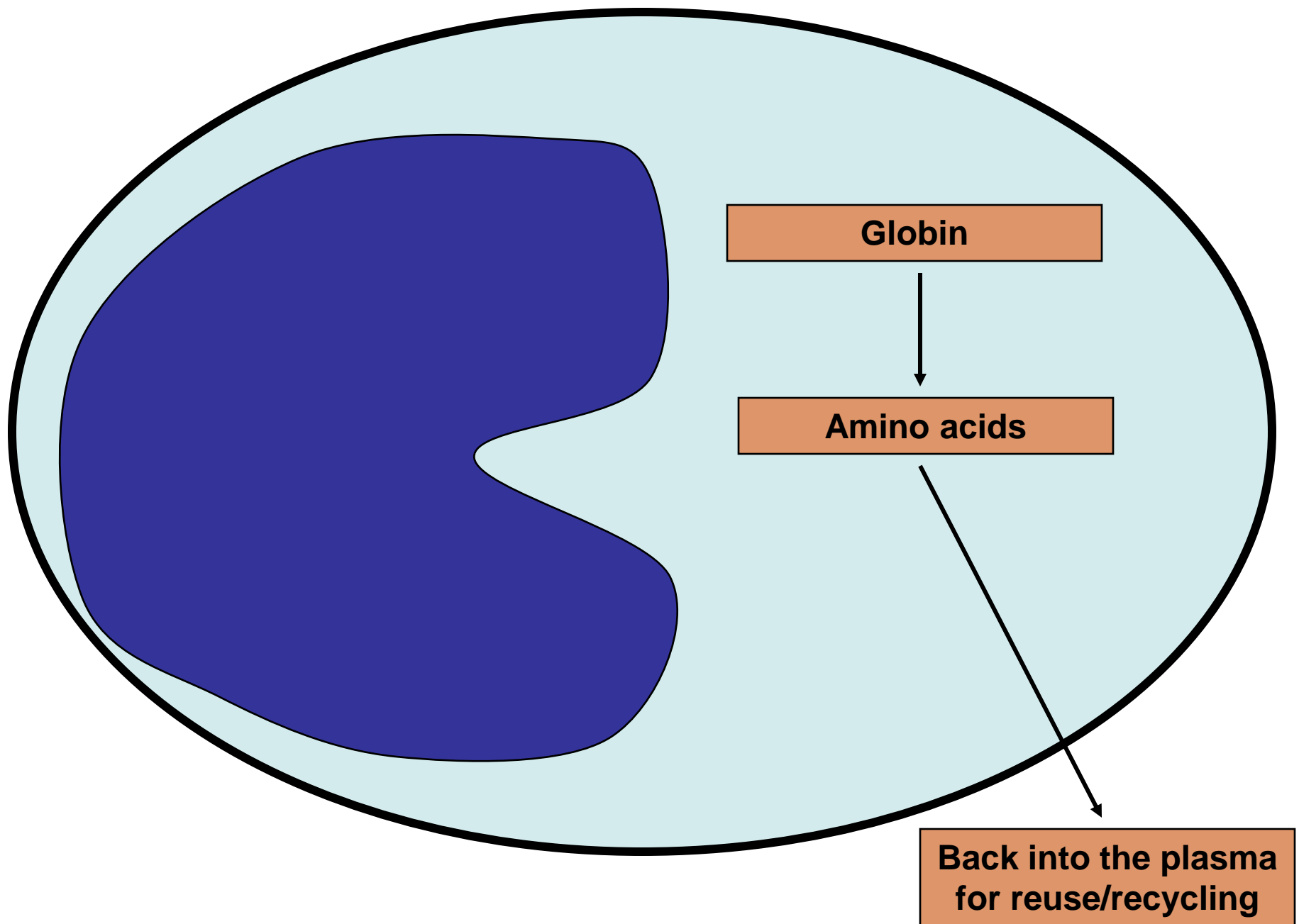
Circulates for 120d

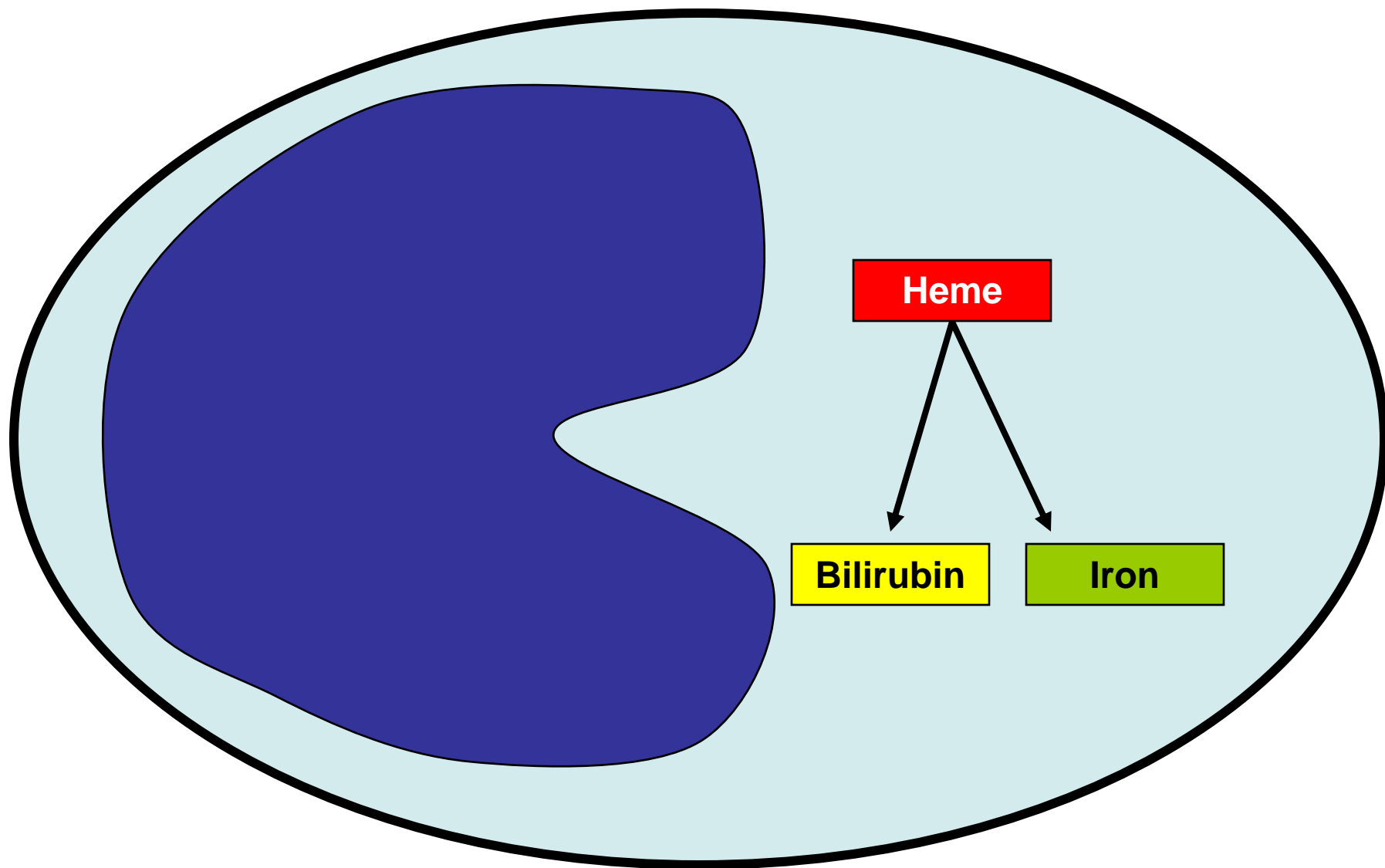
Swallowed by a macrophage

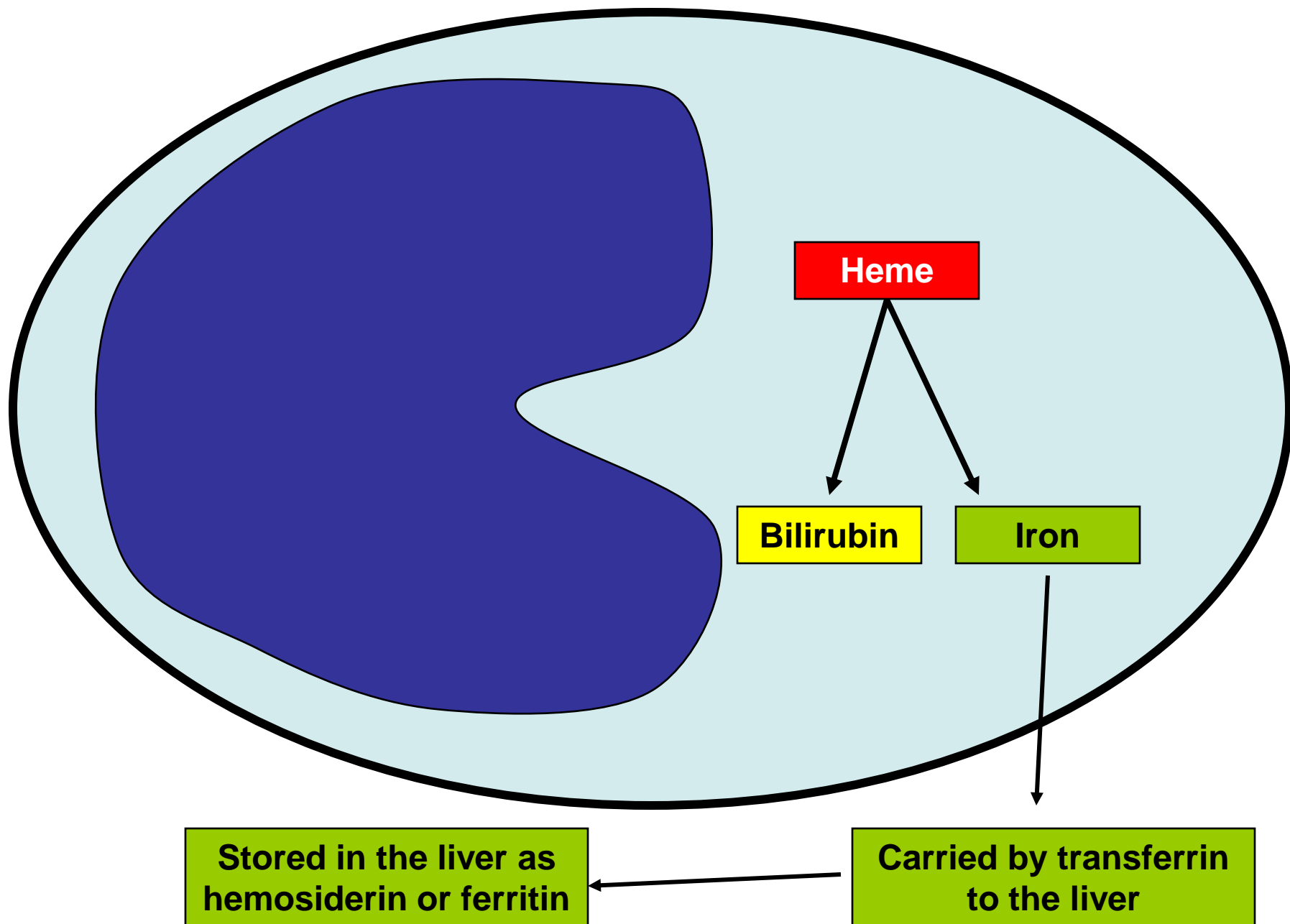


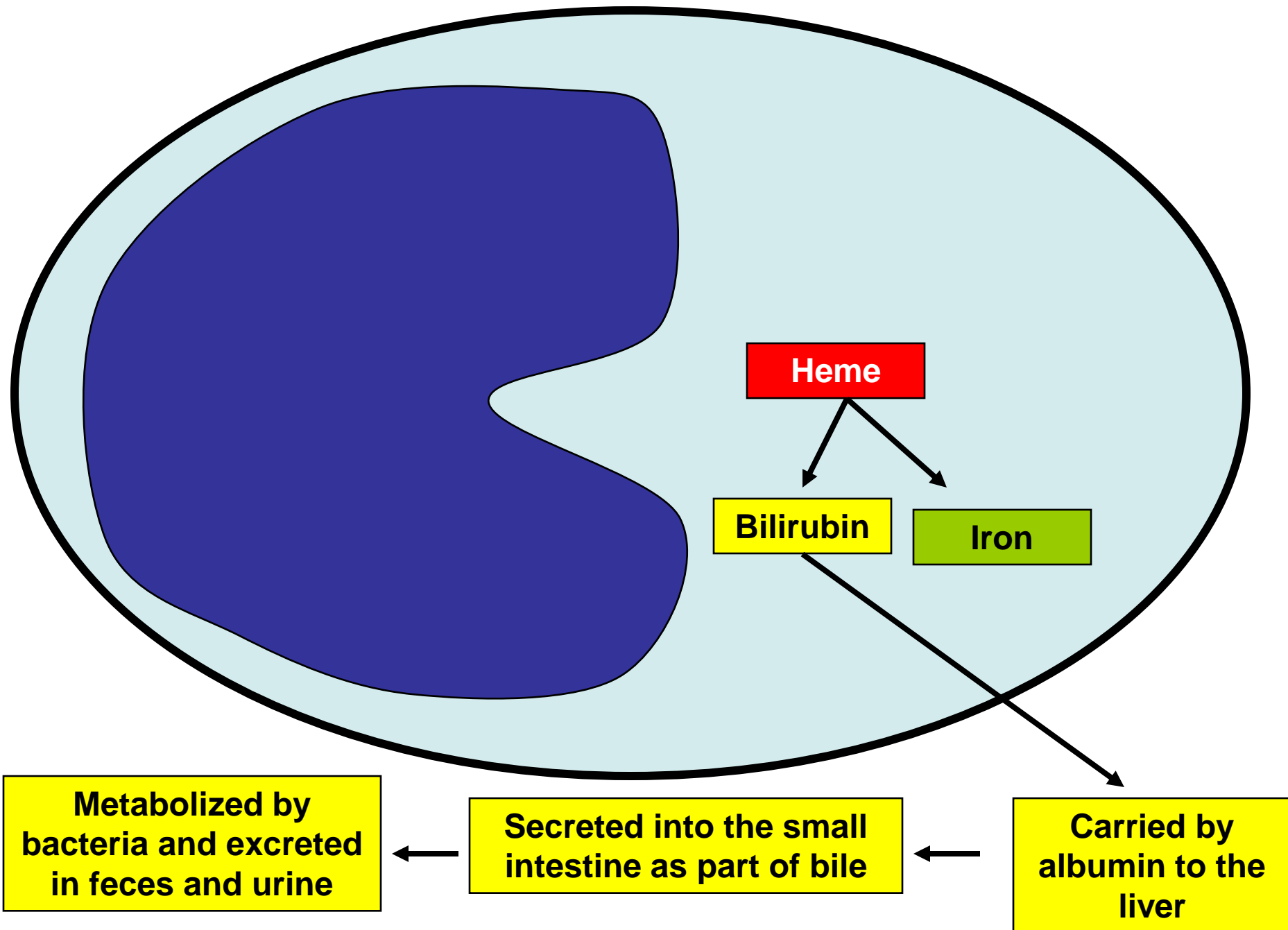
Macrophage





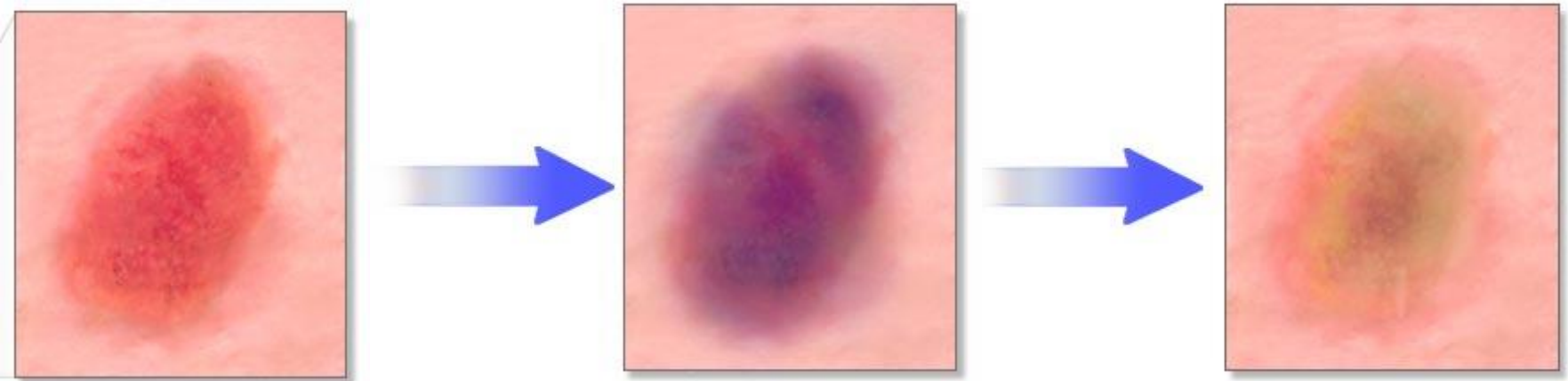




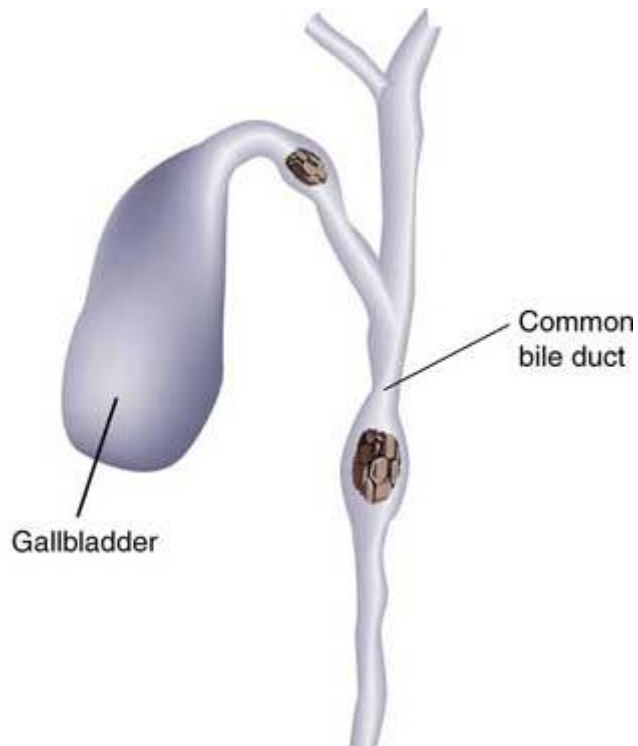


Consider a bruise. The initial color is due to blood in the interstitial spaces.

- *As a bruise turns purple, green, and then yellow, what must be occurring?*
- *What must be occurring as the yellow color fades away?*



An accumulation of bilirubin can cause the skin and sclera to take on a yellowish hue.



**Carbon monoxide blocks Hb's binding site for O₂.
Nicotine is a vasoconstrictor.**

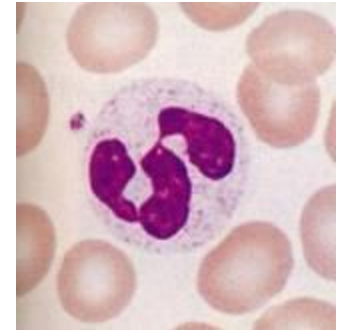
Cigarette smoke contains both.

If a non-smoker began smoking a couple packs a day for a few weeks, how would this affect his:

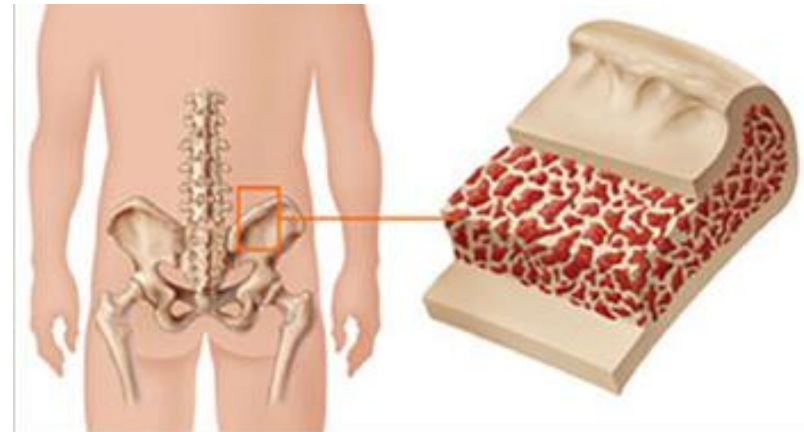
1. Plasma EPO levels
2. Red blood cell count
3. Blood viscosity
4. % of blood occupied by RBCs
5. % of blood occupied by plasma

Leukocytes (WBCs)

- The only formed elements with a...



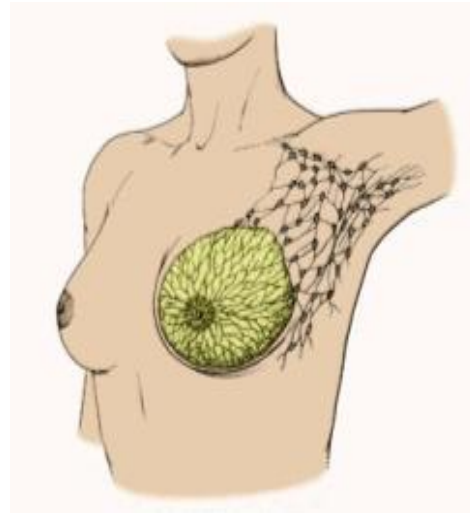
- *Site of leukopoiesis?*



- *From what cell are they derived?*

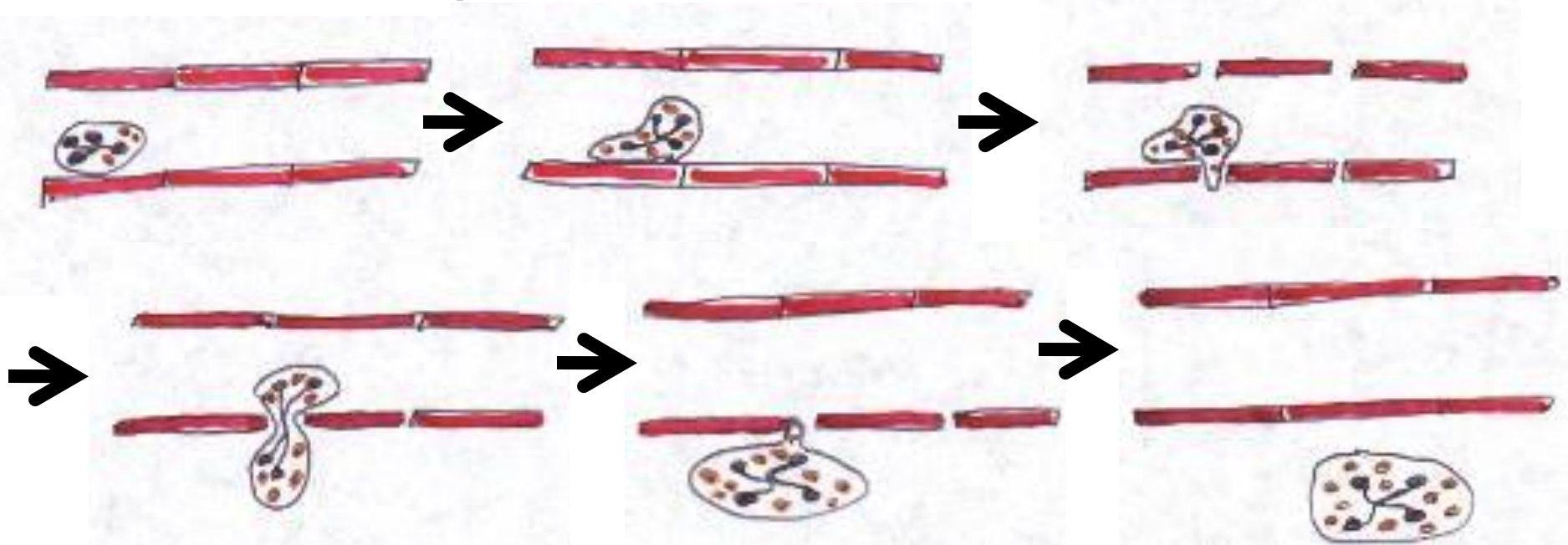
Leukocytes (WBCs)

- Make up <1% of blood.
- 5,000 to 10,000 WBCs per μL of blood.
- *Location?*
- *Function?*



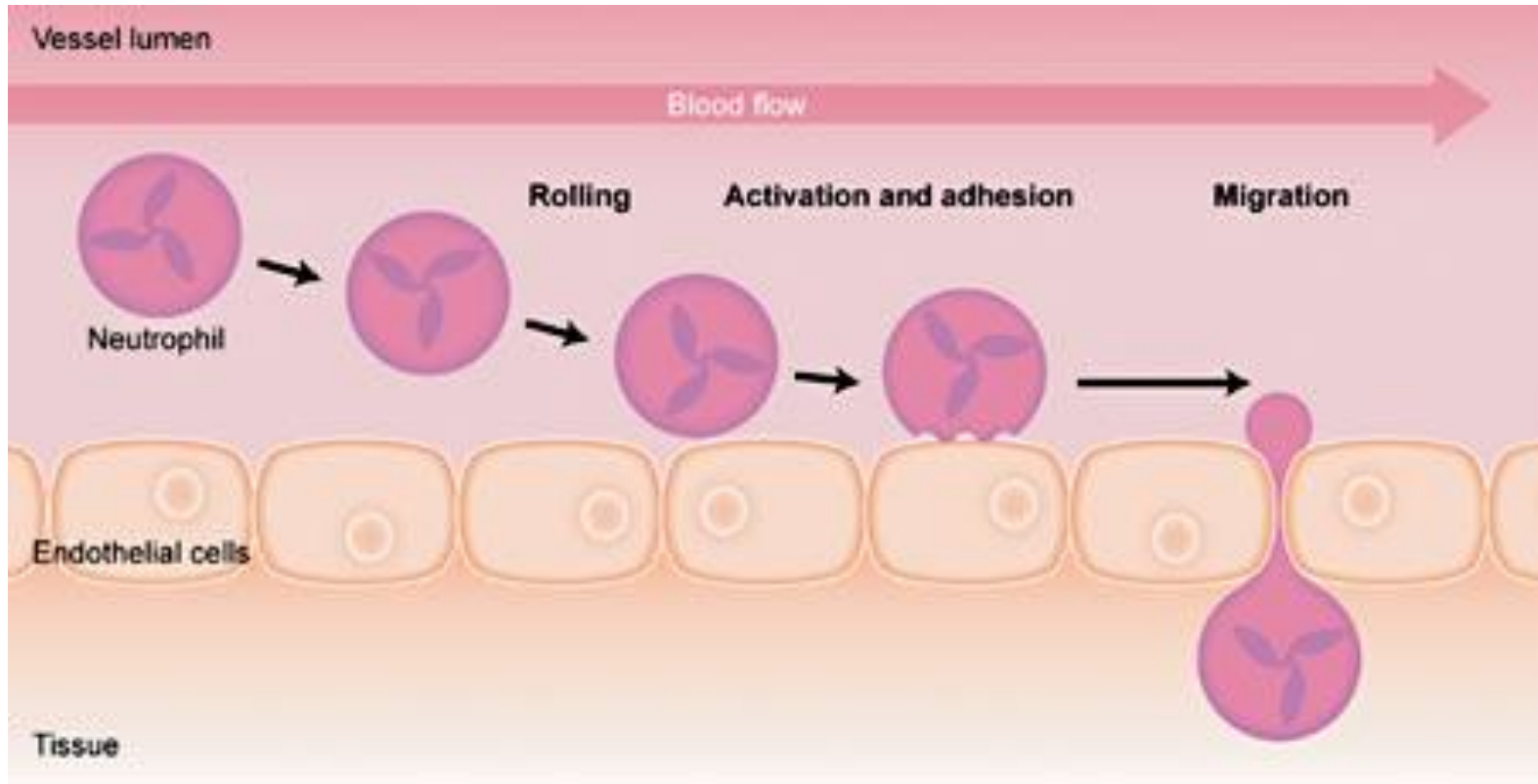
Leukocytes (WBCs)

- Perform diapedesis.



- *Why is this necessary?*

- *How does a WBC know when/where to perform diapedesis?*



- Chemotactants

2 Classes of Leukocytes (WBCs)

1. Granulocytes.

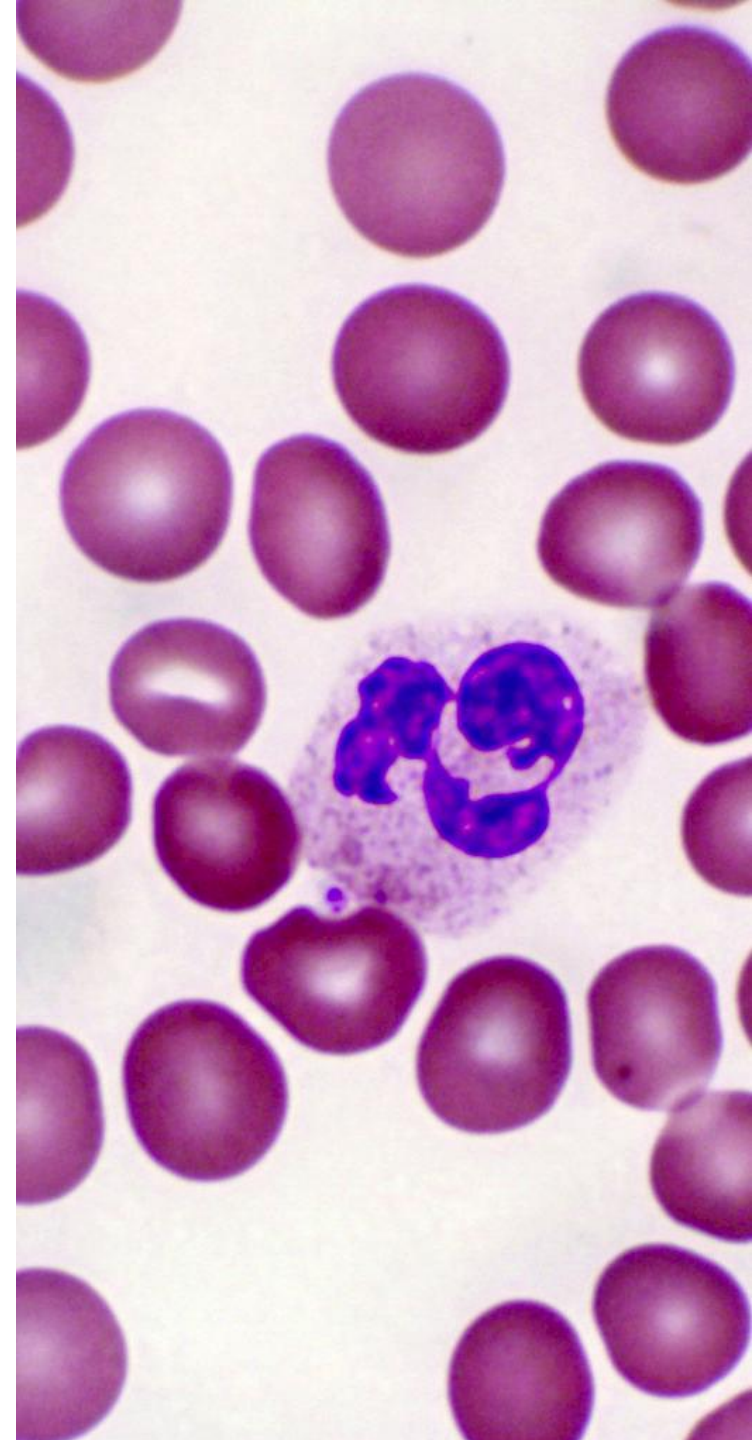
- Contain stained granules.
- Neutrophils
- Eosinophils
- Basophils

2. Agranulocytes.

- Lack stained granules.
- Lymphocytes
- Monocytes

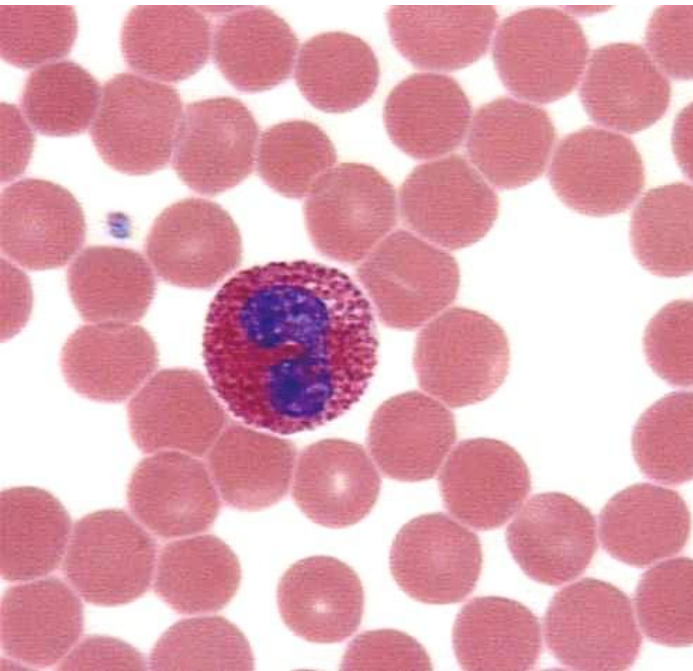
Neutrophils

- 60% of circ. WBCs.
- Polymorphonuclear leukocytes
- Bacteria killers.
- Live up to a few days.



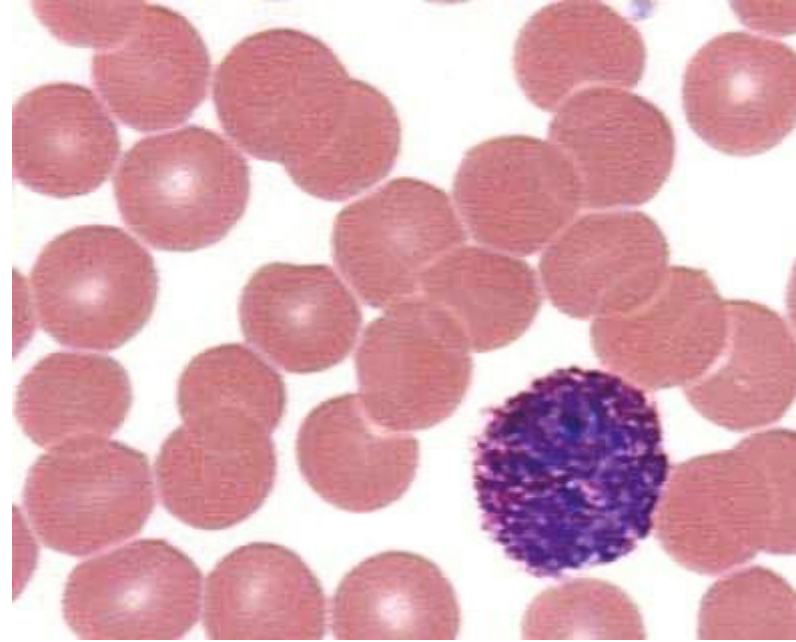
Eosinophils

- 3%
- Kill parasitic worms.
- Live about 5 days.



Basophils

- $<1\%$
- Inflammation.
- Live up to a few days.
- Contain:
 - Histamine – a vasodilator
 - Heparin – an anticoagulant



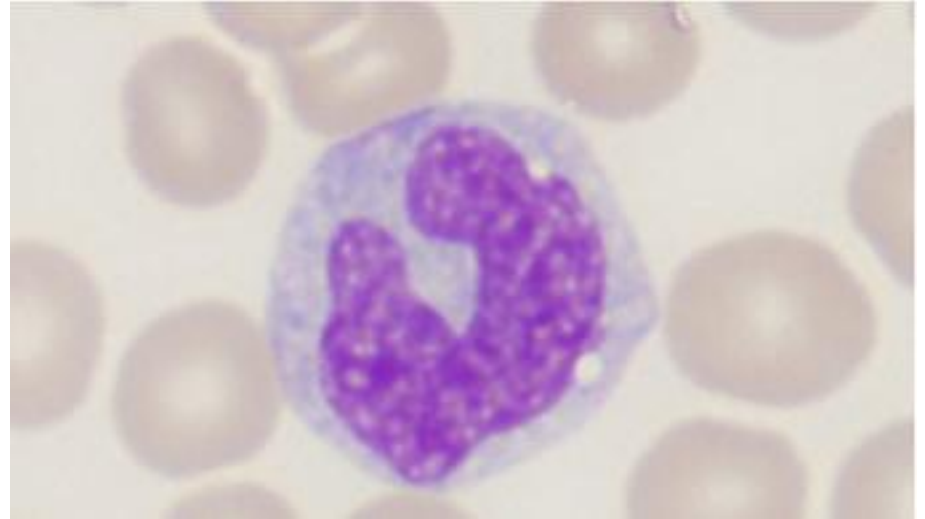
Lymphocytes

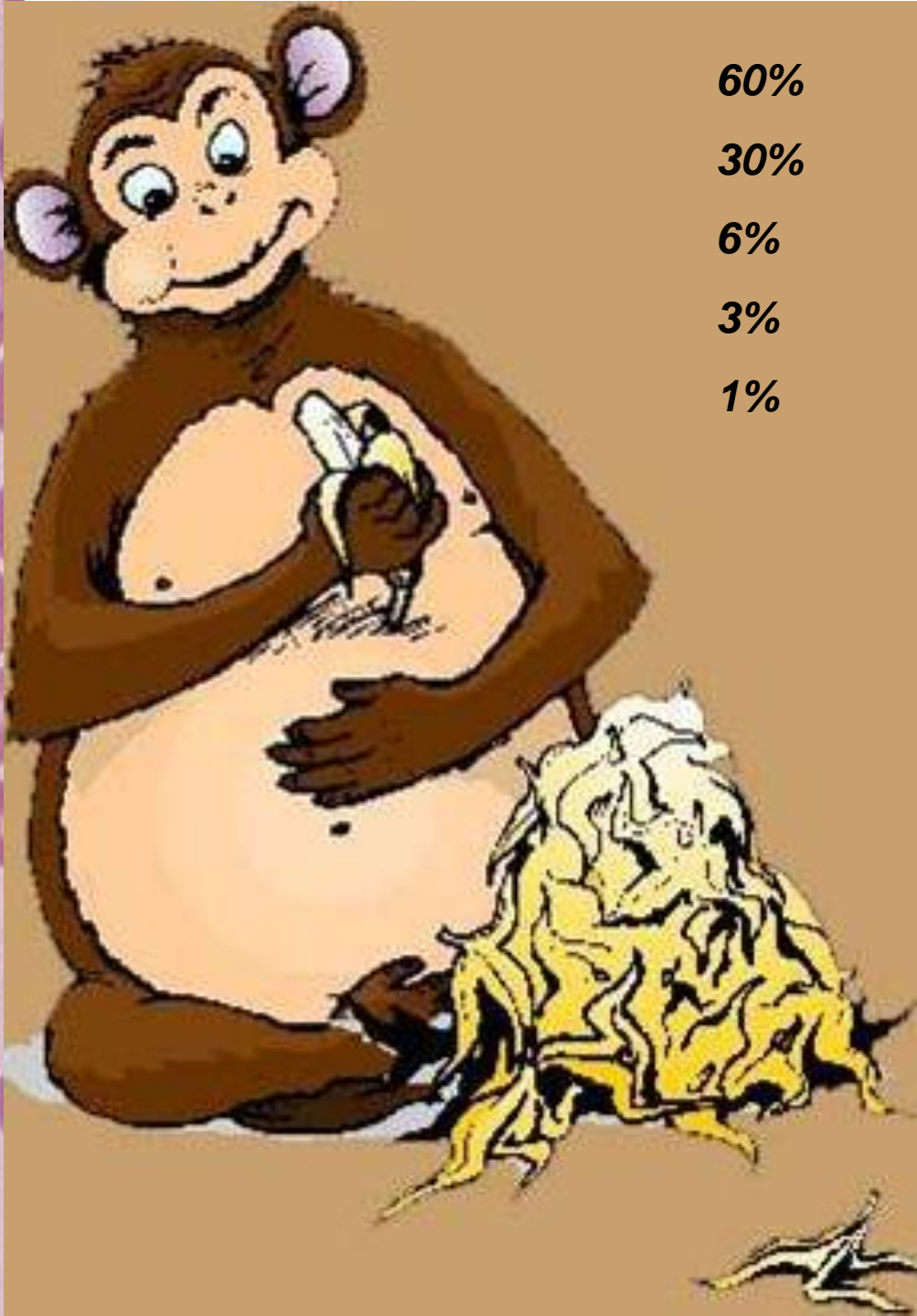
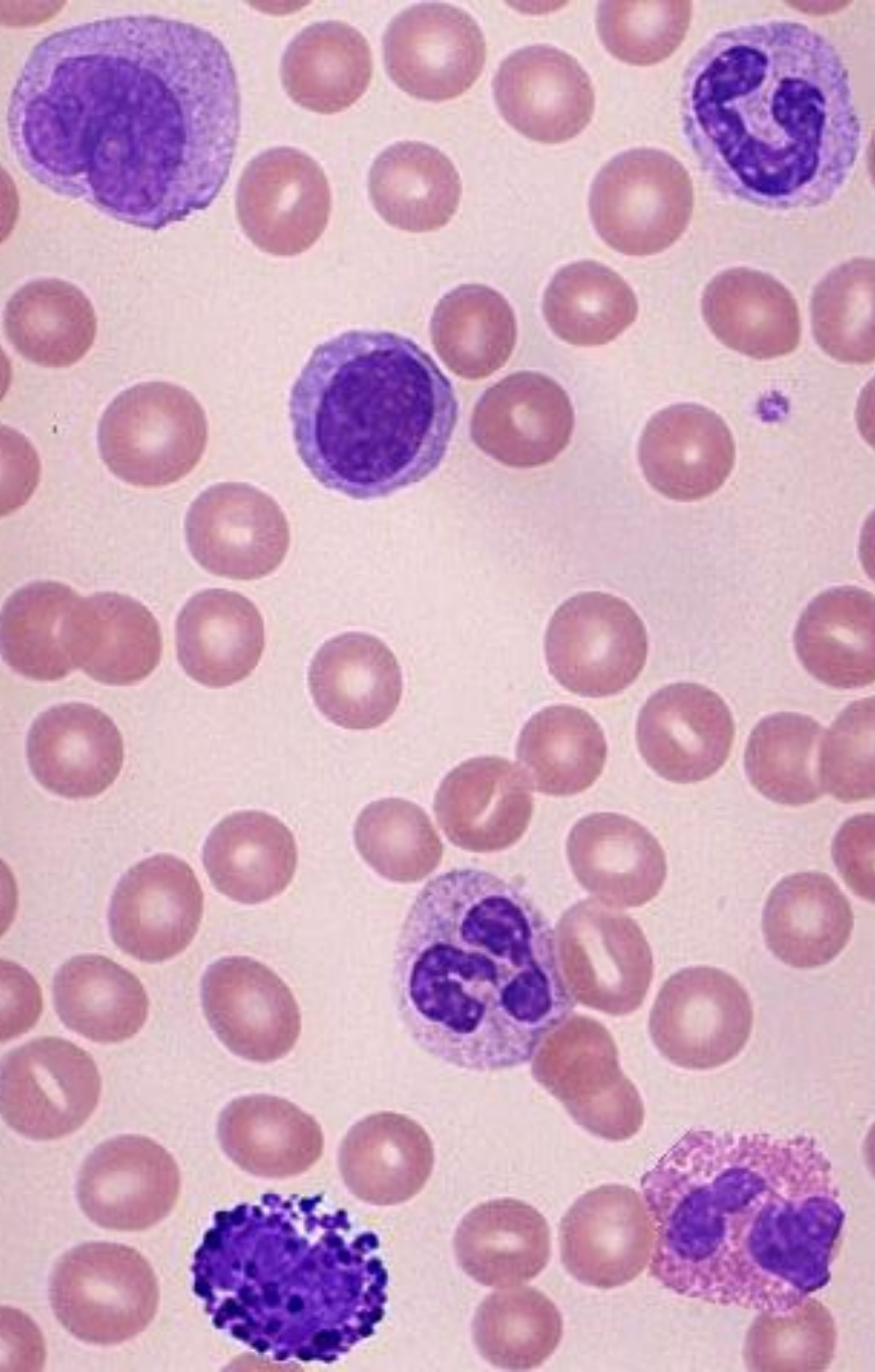
- 30%
- Relatively small # in blood.
- Most are in lymphatic tissues.
- Can live for years.
- 2 main types:
 - T lymphocytes – control/coordinate/kill
 - B lymphocytes – secrete antibodies (immunoglobulins)



Monocytes

- 6%
- Become macrophages
- Can live for months.





60%

30%

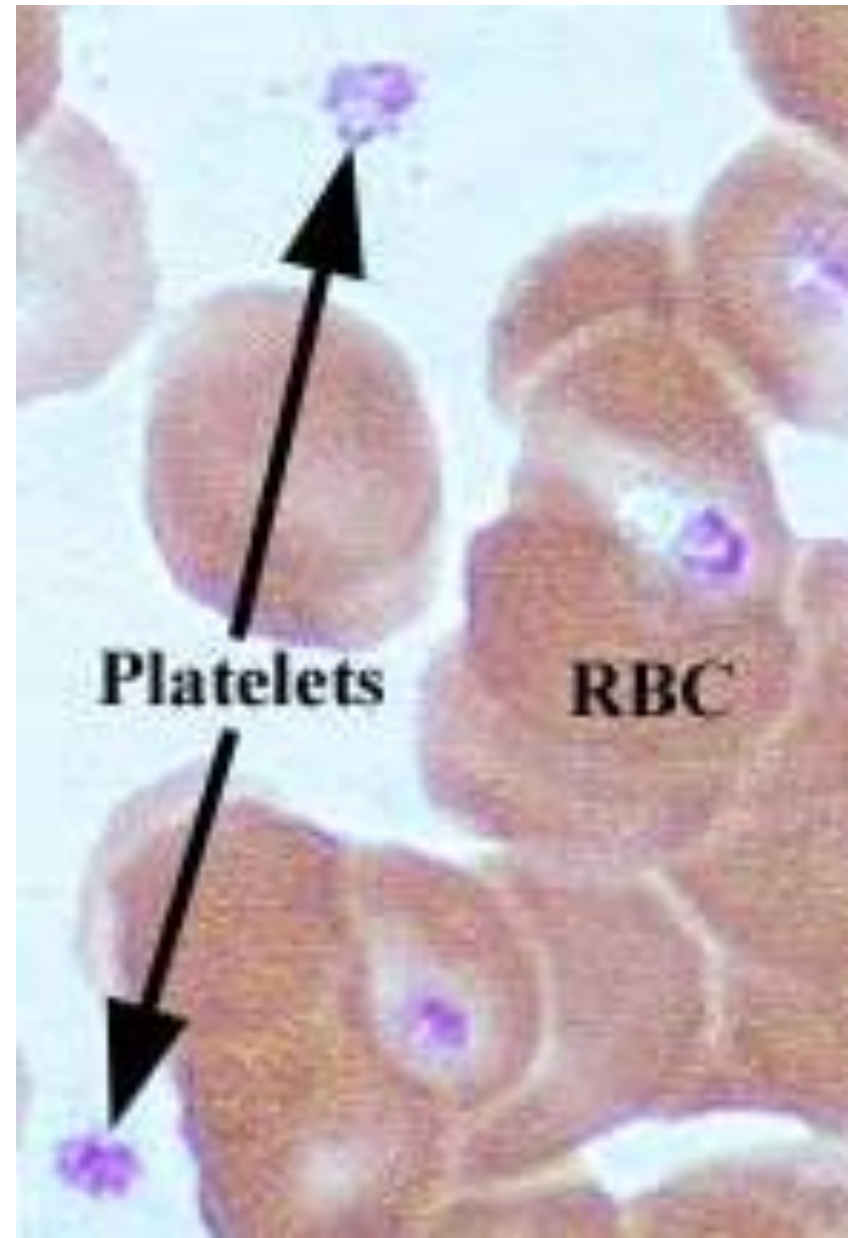
6%

3%

1%

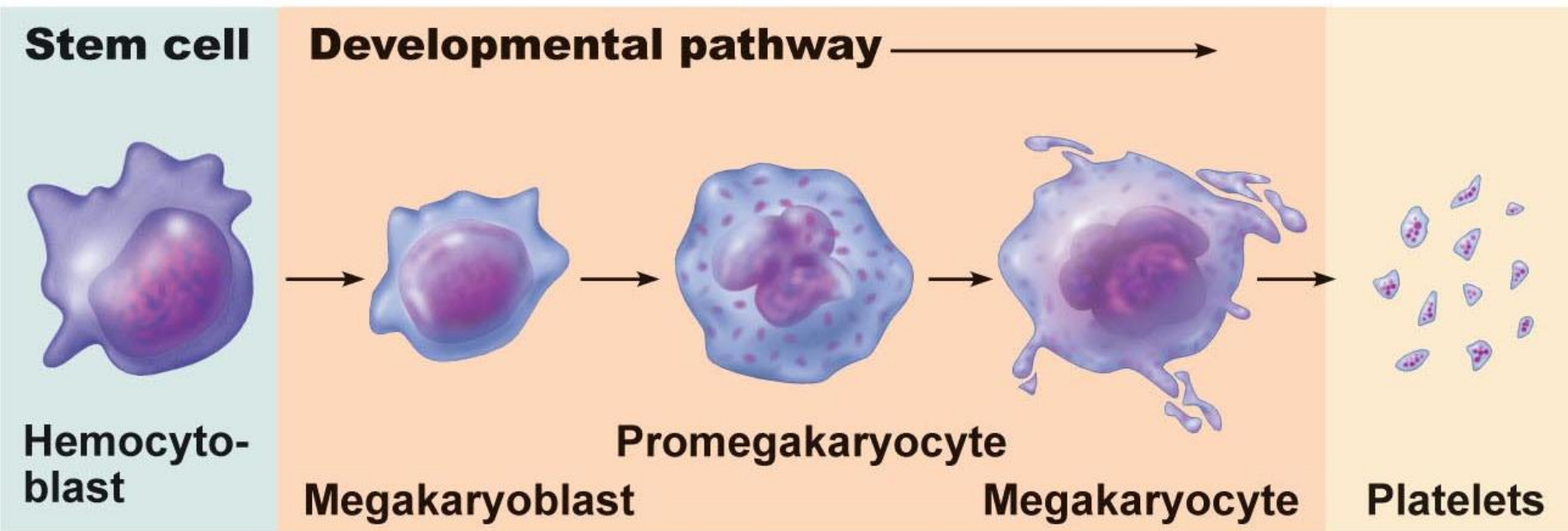
Platelets

- Cell fragments
- Hemostasis
- Thrombocytes
- 150,000 – 450,000 per μL of blood



Platelets

- *Where are they produced?*
- *From what stem cell are they derived?*
- *Thrombopoiesis and thrombopoietin*



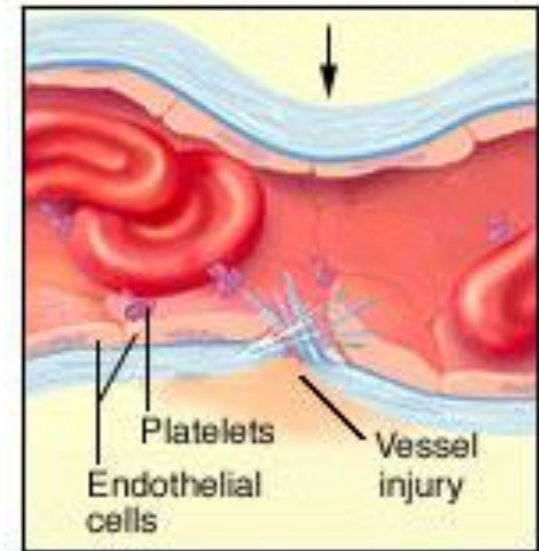


Hemostasis

- Set of processes that stop bleeding and promote healing of damaged blood vessel walls.
 - Vascular spasm
 - Platelet plug formation
 - Coagulation

Vascular Spasm

- In response to damage, vascular smooth muscle will contract and this will cause:
 - *The diameter of the vessel to:*
 - *Blood flow through the vessel to:*
 - *Blood pressure within the vessel will to:*

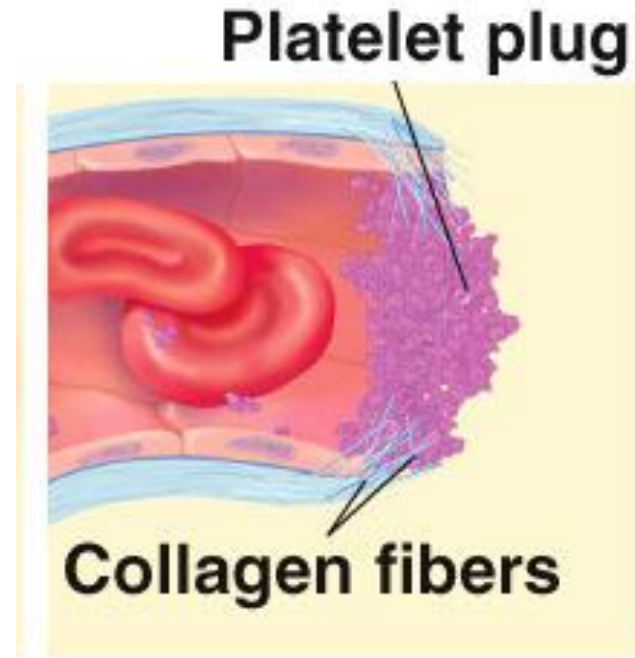


Platelet Plug Formation

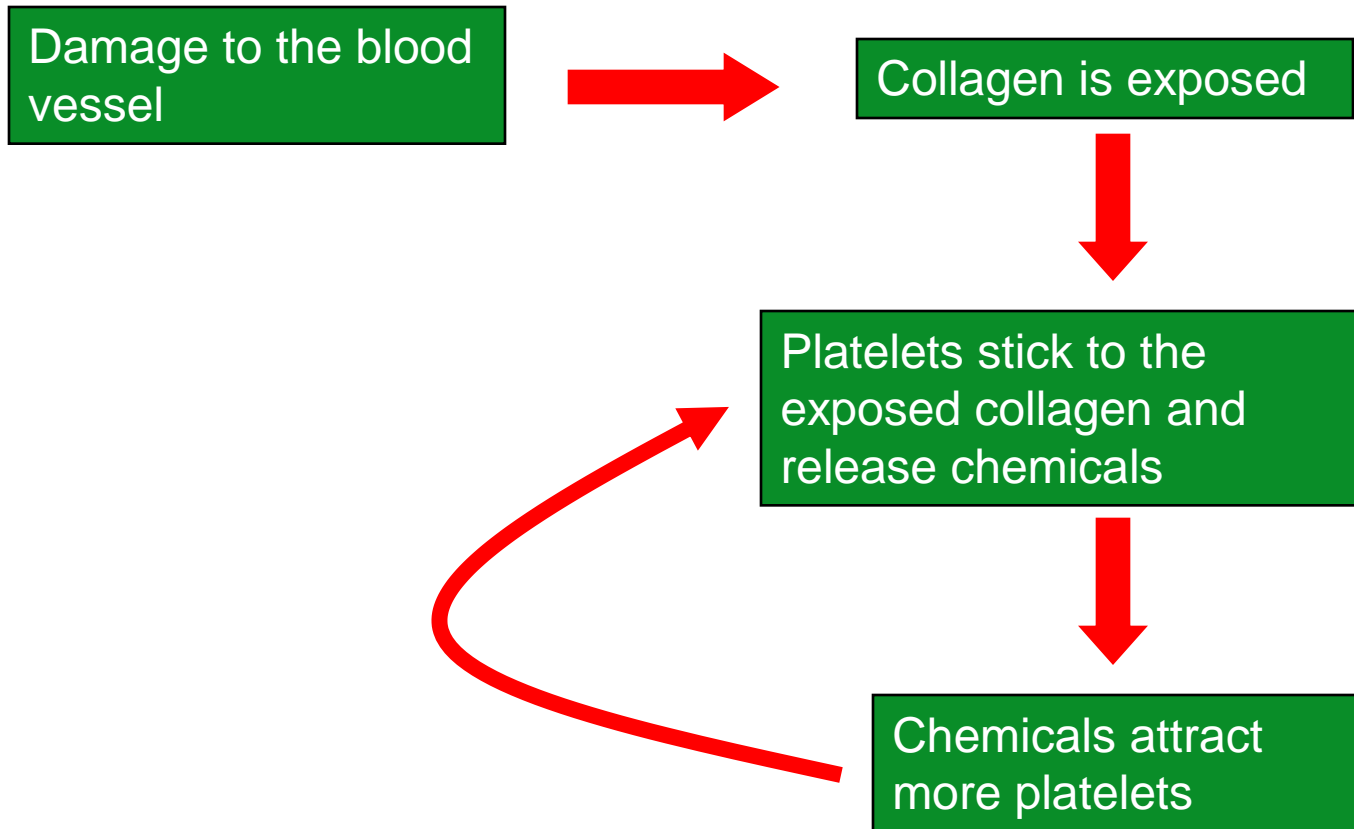
- Mass of platelets covers the damaged area.

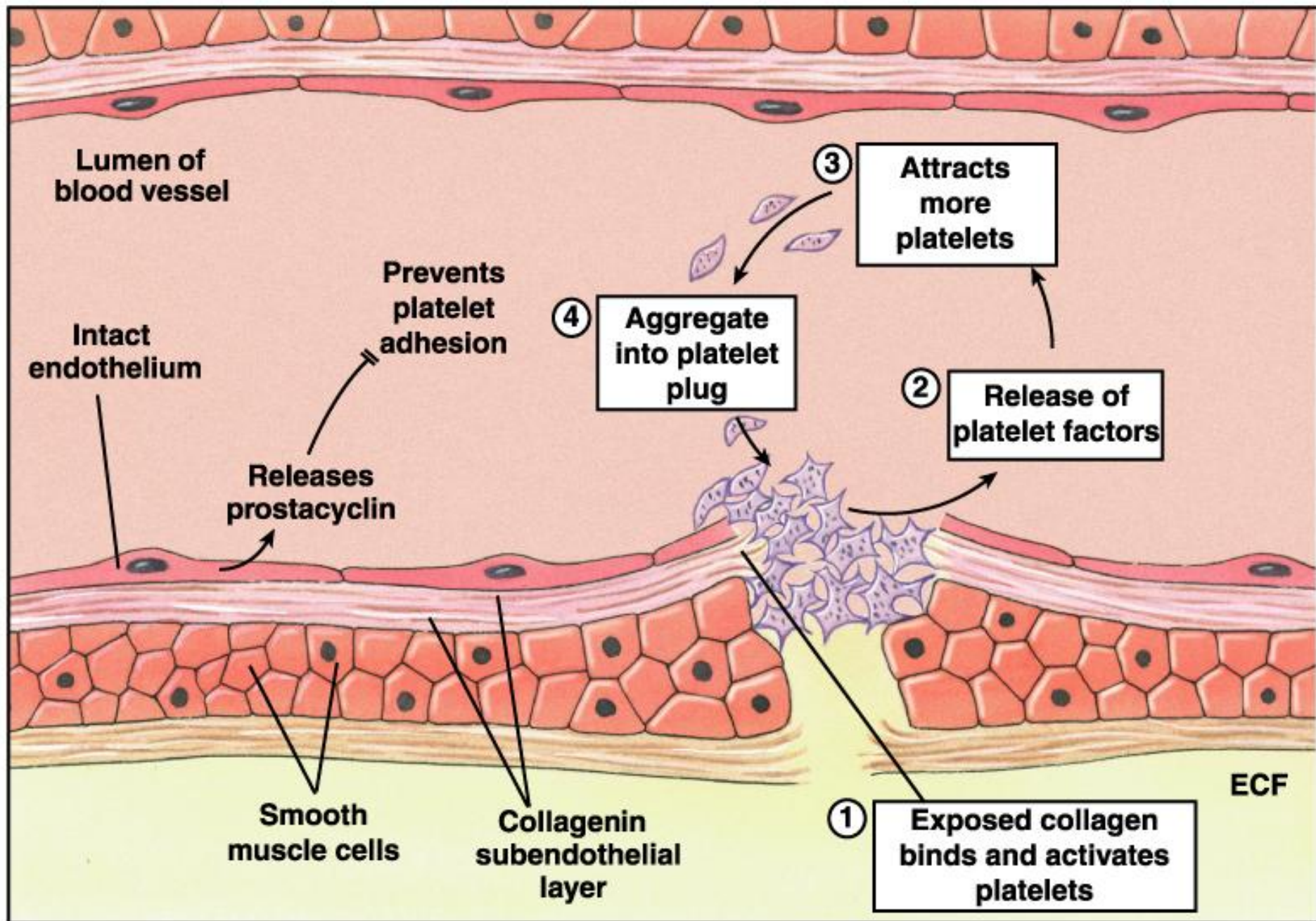
- *What's the point?*

- *What replaces it?*



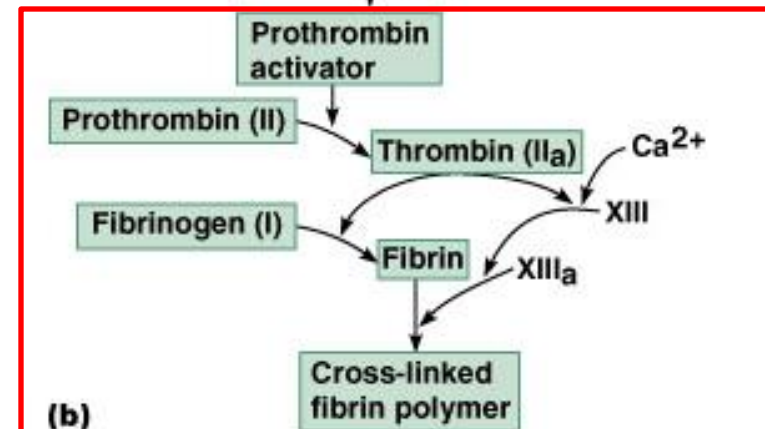
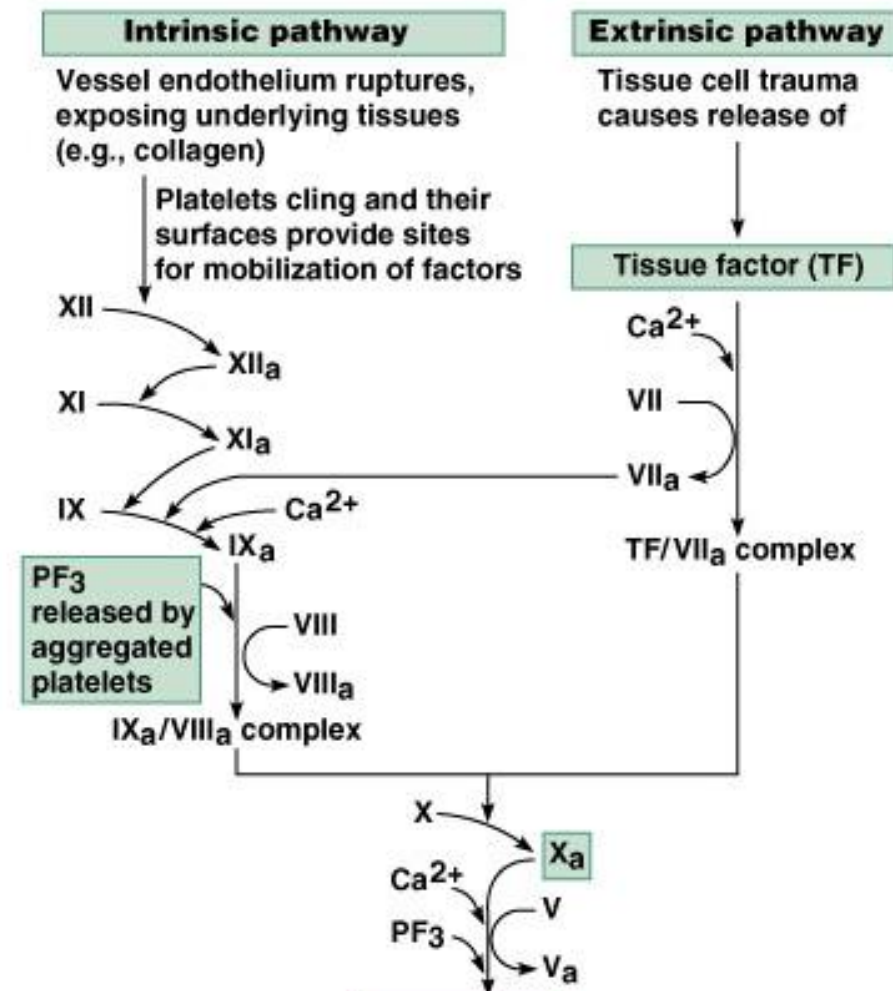
Platelet Plug Formation





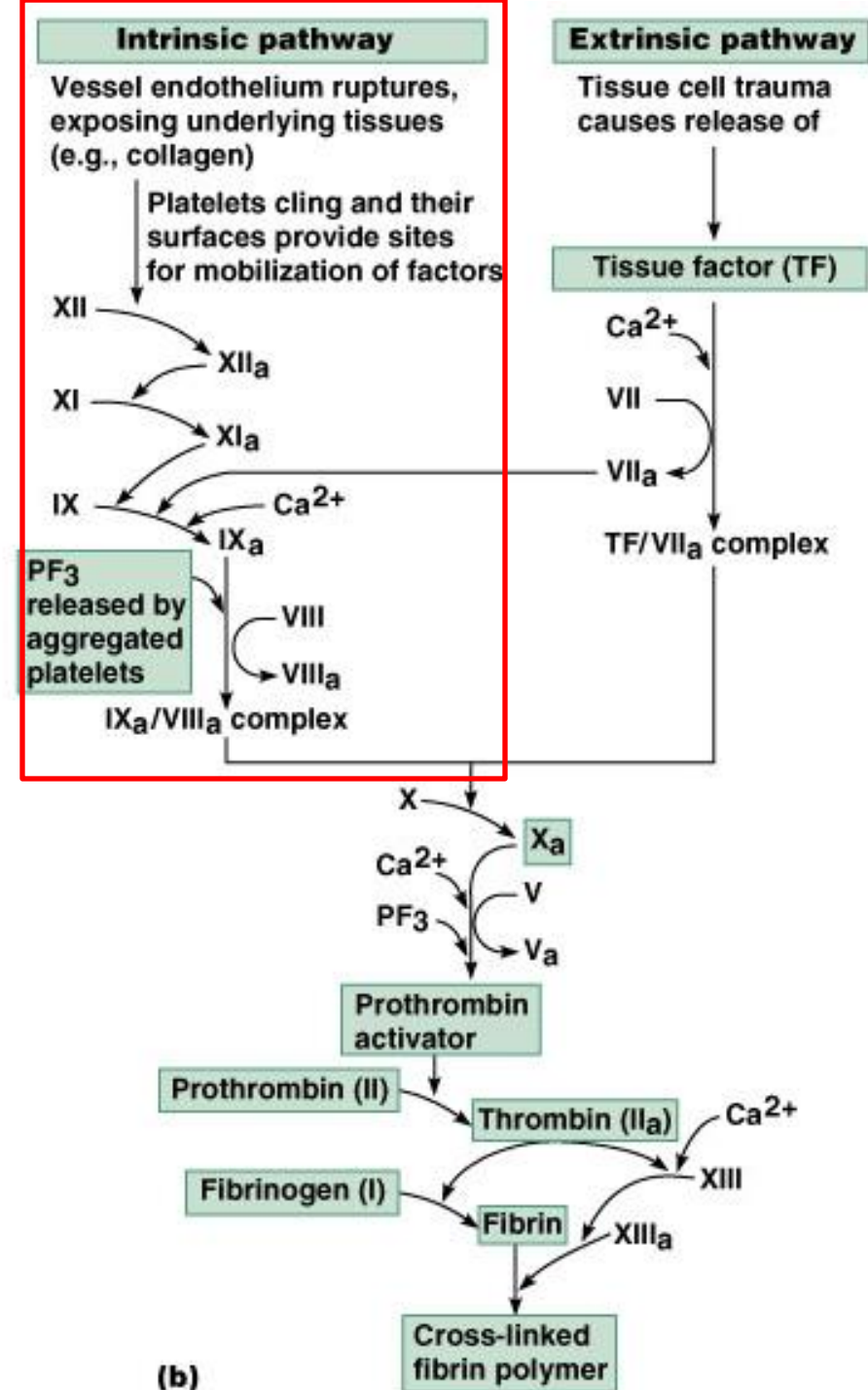
Coagulation

- Clot formation
- We'll focus on the last steps of coagulation:
 - Formation of prothrombin activator
 - Formation of thrombin
 - Formation and cross-linking of fibrin



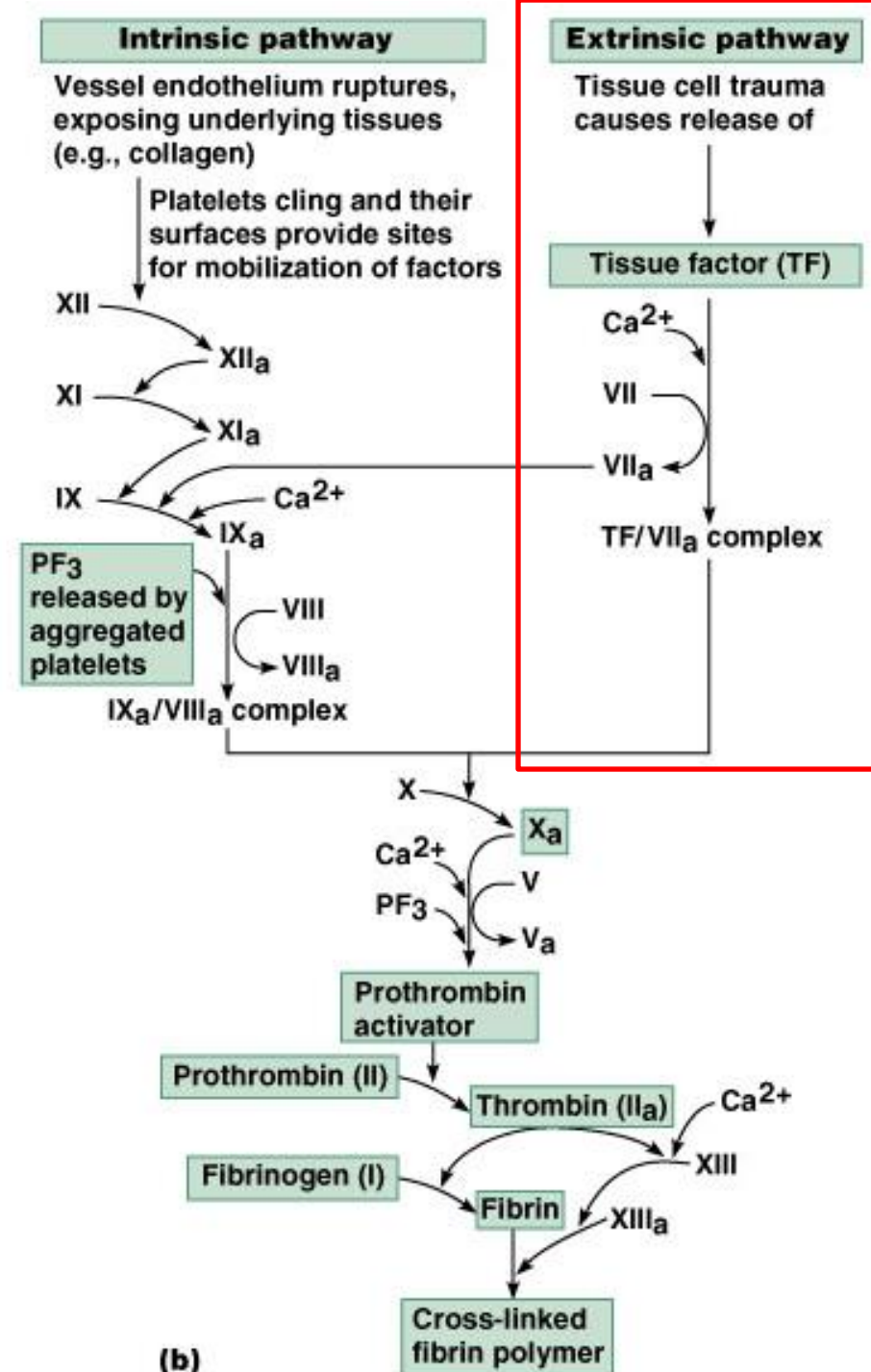
Making Prothrombin Activator

- Intrinsic path
 - Begins in response to damage to the blood vessel wall.
 - Many steps.
- *Disadvantage?*
- *Advantage?*



Making Prothrombin Activator

- Extrinsic path
 - Begins in response to certain chemicals released by damaged tissues outside the bloodstream.
- Few steps
 - Disadvantage?*
 - Advantage?*



Making Thrombin and Fibrin

Prothrombin Activator

Prothrombin

Thrombin

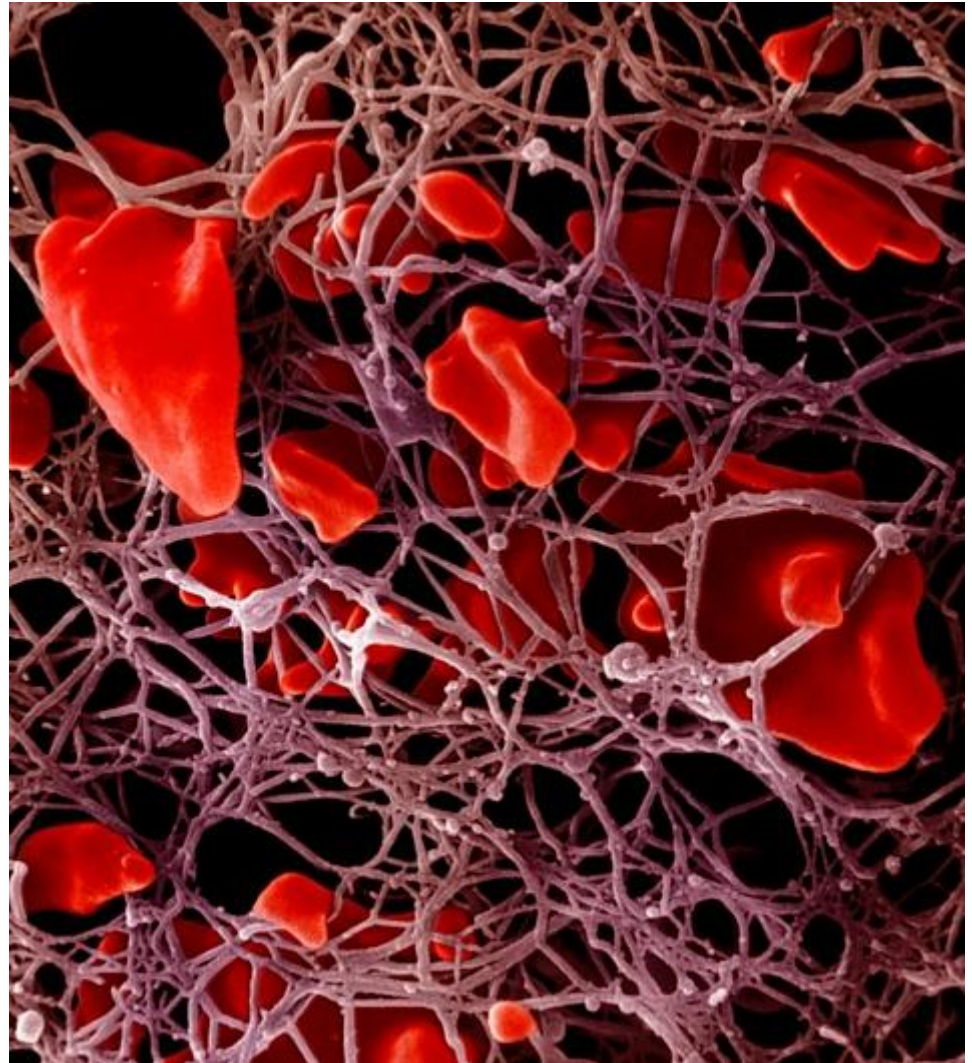
Fibrinogen

Fibrin

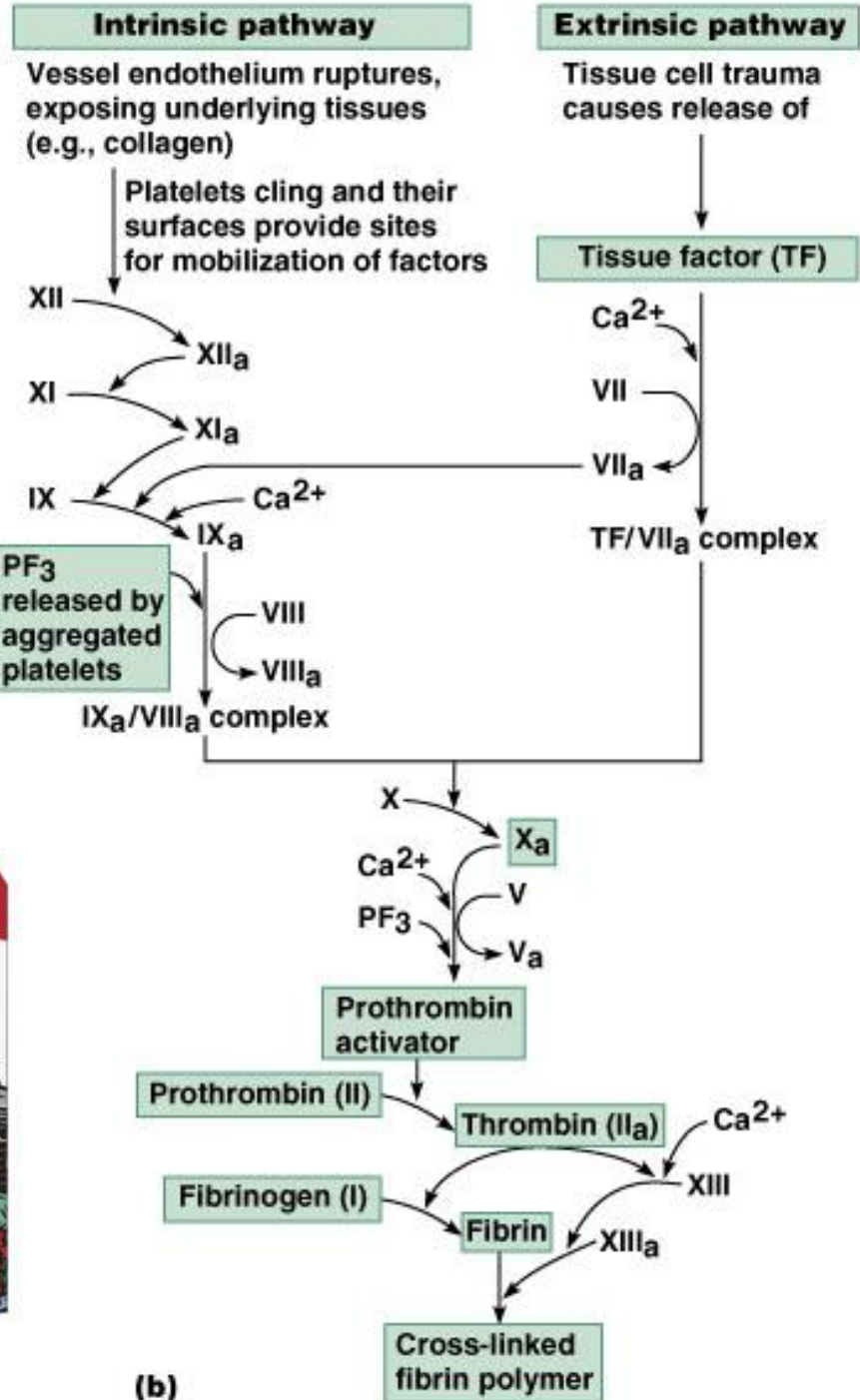
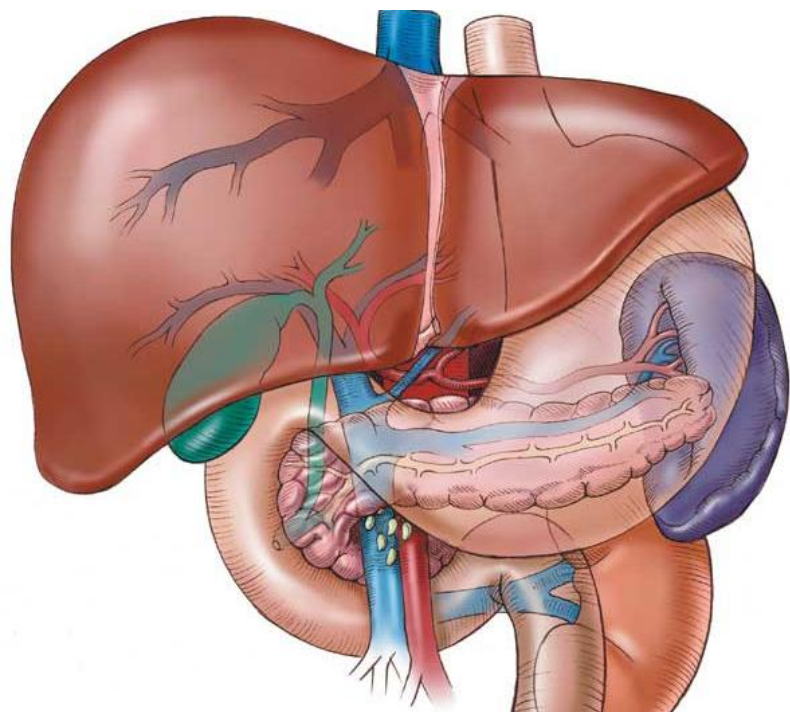


What does fibrin do?

- Forms a mesh around the damaged area.
- Cross-links
- Traps

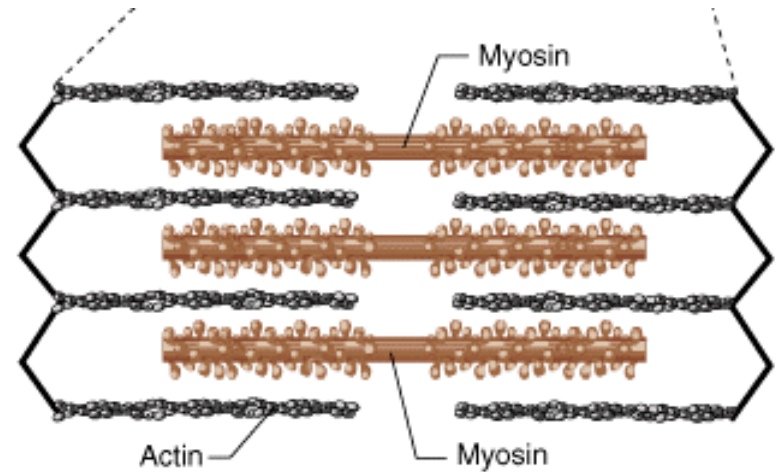
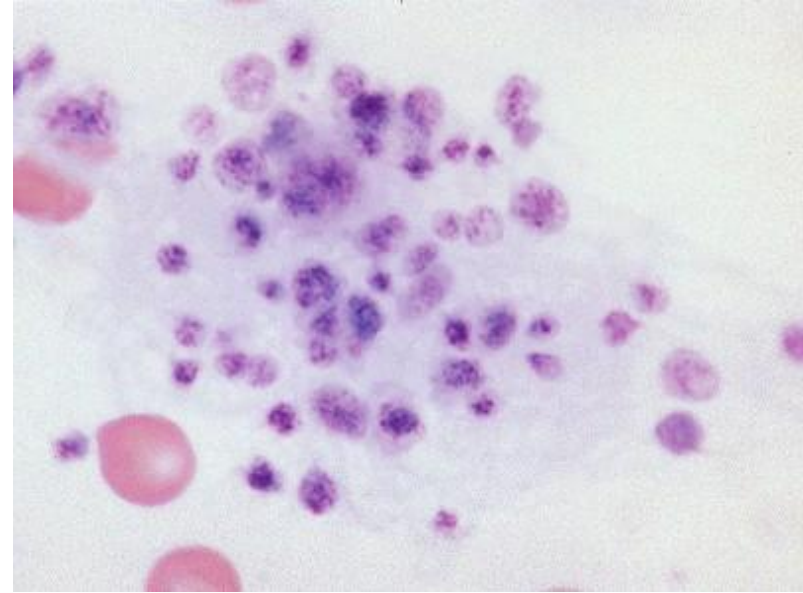


Koagulation



Clot Retraction

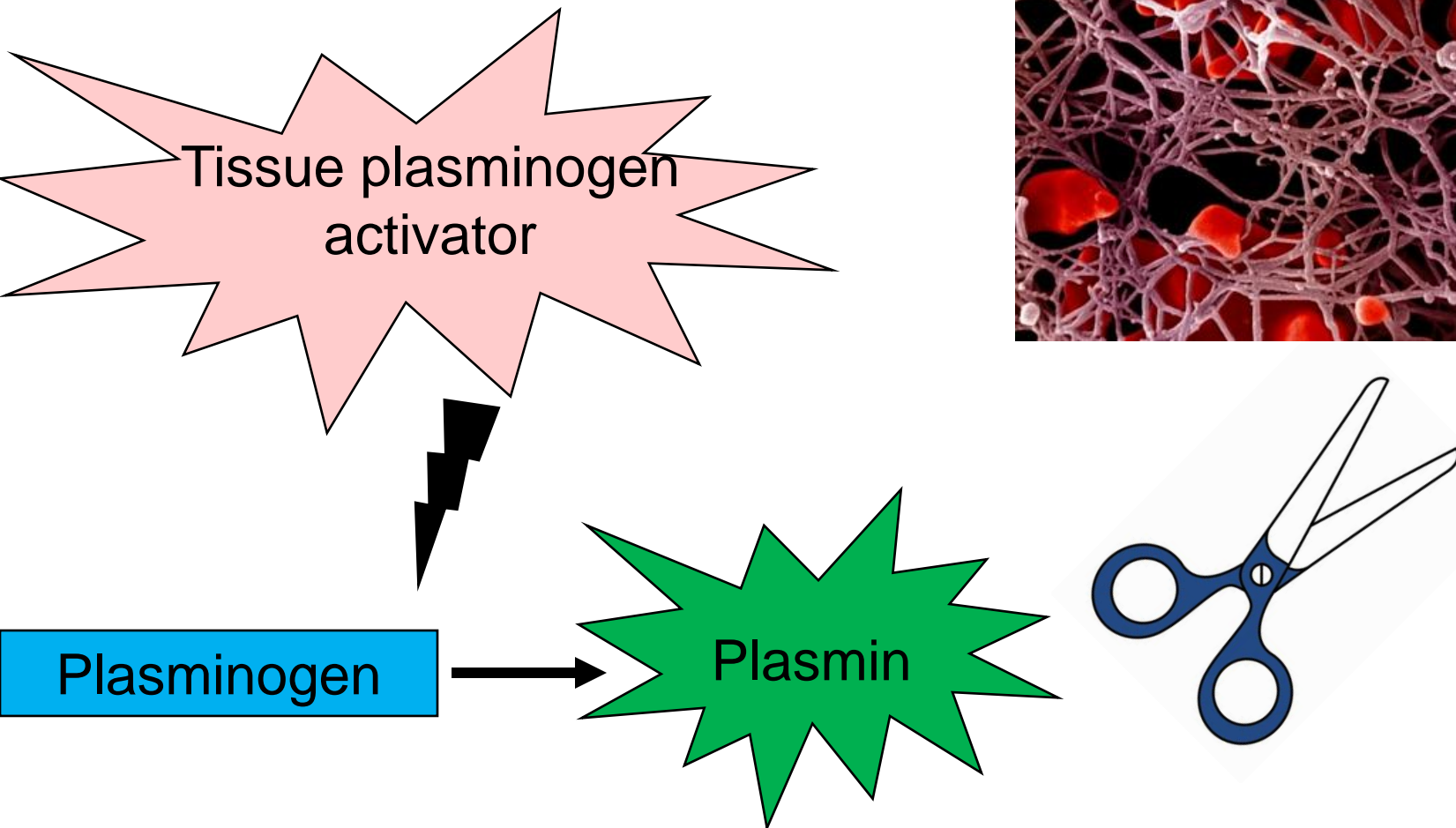
- Platelet contractile proteins
- Squeezes serum out
- Draws edges together.
- Sets the stage for repair.

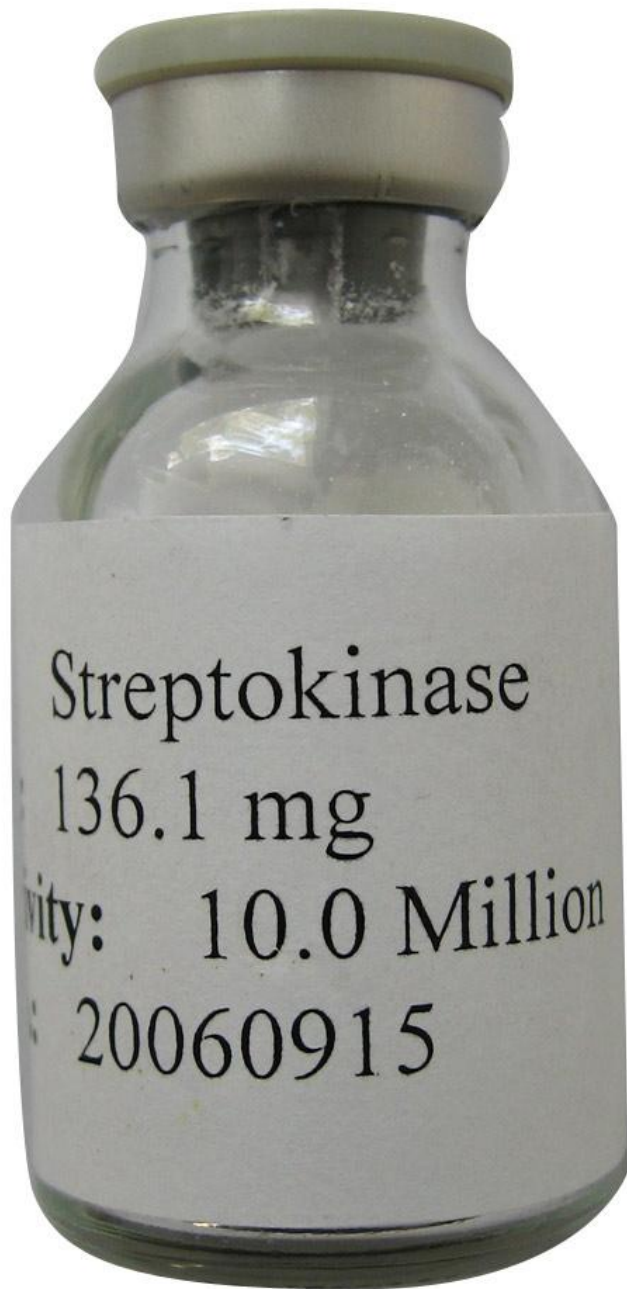


Fibrinolysis



- *When?*





Heart attacks are often caused by blood clots blocking coronary blood vessels. What could streptokinase do to help someone who is having a heart attack?

Normal Clot Growth

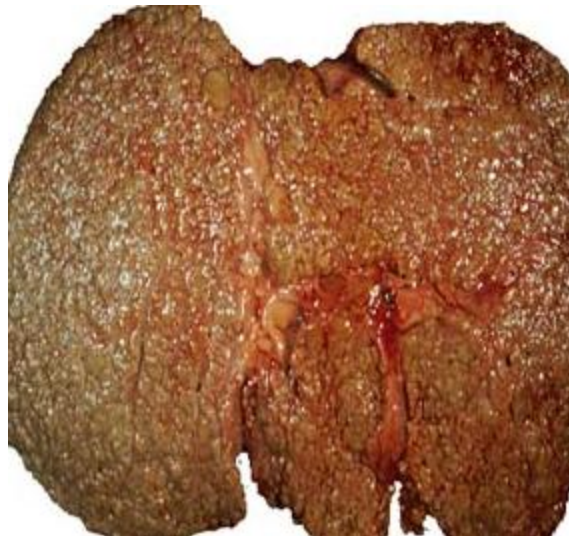
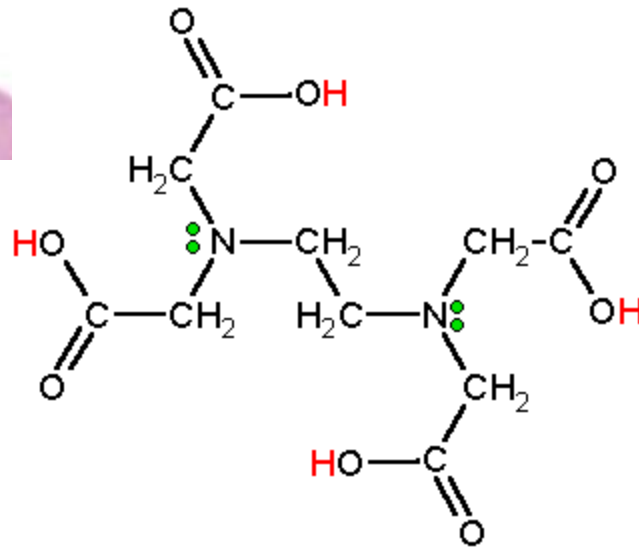
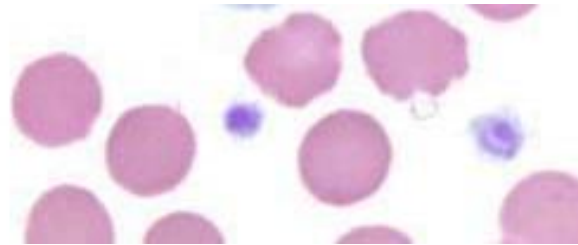
- When?
- Procoagulants vs. Anticoagulants
- Quick removal
- Inactivation

Things that promote abnormal coagulation:

- Rough blood vessel lining
- Pooling of blood



Things that impair coagulation:



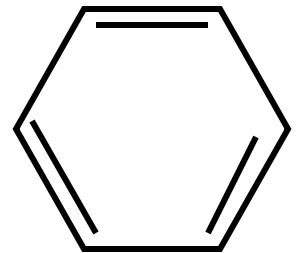
Mosquito saliva contains an enzyme called apyrase.

Which of the following is it most likely to do?

- a. Inhibit fibrinolysis
- b. Promote thrombin production
- c. Inhibit platelet aggregation
- d. Promote fibrin production



Individuals with atrial fibrillation can have blood pool in their atria. *What danger could this pose?*



Causes the destruction of red bone marrow. This would cause the body's ability to:

- Transport oxygen to:
- Fight infection to:
- Prevent blood loss to:

WHY?